APRIL 1958

Power Engineering

ATOMICS

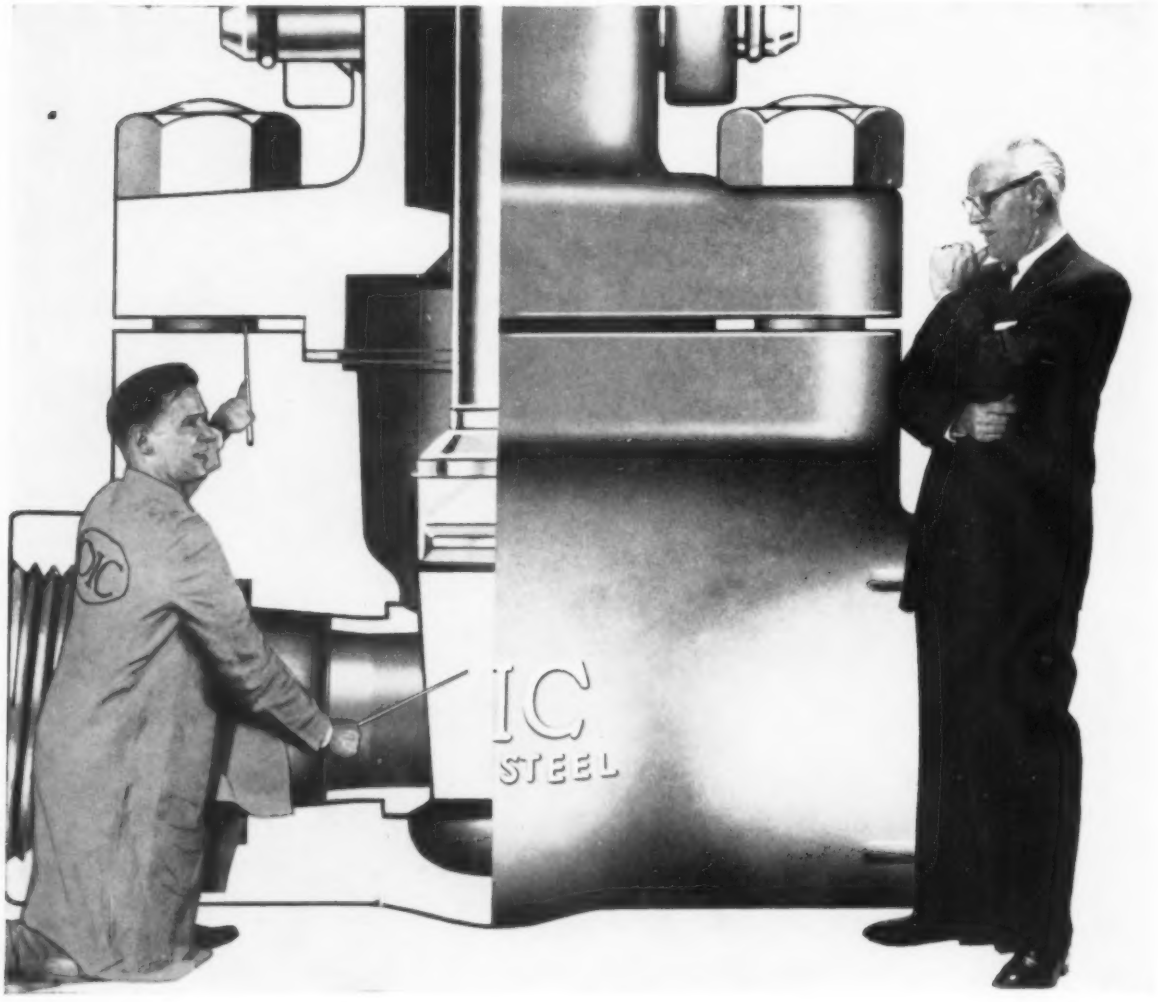
Time to Stop Baiting Scientists 43
Thermonuclear Progress in U. S. and Britain 44
Nuclear Development in Eastern Europe 47
How the APPR Was Prepared for Start-Up 50
New Nuclear Literature 52

TRACERS . . . New Monthly Probe of Power Facts 75
Training New Men for Power Plant Work 76
Common Sense as Applied to Electrical Distribution 79
How About a Central Fuel Committee for EEI? 82
Repairs Cut Down-Time at Con Ed 84
Planning for Power Facilities at UCLA Medical Center 88
System Changes Affect Parallel Pump Operations 91
AIEE Winter Meeting Attracts 5000 Electrical Engineers 96
Gas Pipeline Power Facilities 98
Which Salt for Industrial Water Treatment? 100
Metallizing Superheater Tubes 103
Fractured Runner Blades Welded at Site 104

REGULAR DEPARTMENTS

Engineers' Preview	3	Equipment News	116
What They Tell Us	6	New Engineering Books	138
Helpful Bulletins	43	Catalog Library	141
News Reel	94	Reader Service Post Cards	141
Power Engineering Handbook	106	Advertisers' Index	156
Construction News	114	Circulation of This Issue	42,510

...and you can see here....and here, sir, how we've killed maintenance problems on our new forged steel lines.



We stop galling and erosion by giving you 13% chrome stainless steel trim with wedges *duracased* to a rugged *1000 Brinell hardness.*

The square and *bolted* body-bonnet joint makes it easy to service the valve quicker. And it's a tighter joint, made doubly leakproof by recessing the soft iron gasket into the body. The gasket can't blow!

And you get the fastest joint make-up you've ever seen. Look at those pipe ends. See the extra wrench-gripping area and lugs. See how body-bonnet flanges are out of the wrench's way. No time lost here!

These new 600-lb. OIC forged steel valves are available with either *high-flow* ports (1300 line), or *standard-flow* ports (1100 line). Call your OIC Distributor, or write for specification literature.

The Ohio Injector Company • Wadsworth, Ohio

OIC VALVES | BRONZE, IRON, FORGED AND CAST STEEL, LUBRICATED PLUG VALVES

ALL IN A DAY'S WORK AT *Pittsburgh Piping*

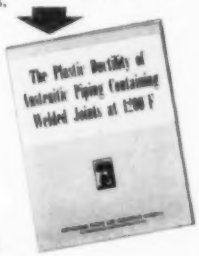
THE FIRST PIPING FOR ATOMIC POWER

Fabricated section in foreground is austenitic steel piping—the first fabricated for the world's first big atomic-power central station. Other components of this system are shown at the right.

This piping is a record maker—being the first ever made for a big atomic-power plant—the Duquesne Light Shippingport station. This job, while challenging, was facilitated by employing the techniques which we had previously developed for fabricating austenitic steel piping for central stations operating at steam temperatures of 1050°F. and higher, as well as for the *Nautilus*. In fact, Pittsburgh Piping was among the first to fabricate stainless steel piping—for the process industries, in 1927. And, we pioneered the use of stainless steel piping materials in the power field. We have the experience and the facilities—use them on your high temperature, high pressure piping jobs.

FREE TECHNICAL BULLETIN ON PIPING MATERIALS

This bulletin reports an intensive investigation into the problem of main steam piping materials and gives data on the stress rupture characteristics of Types 316 and 347 stainless steel piping adjacent to welded joints.



PP-33

Promoting Progress **IN POWER AND PROCESS PIPING**

Pittsburgh Piping **AND EQUIPMENT COMPANY**
158 49th Street—Pittsburgh, Pa.

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Cleveland.....Public Square Building
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New York.....Woolworth Building

For more data circle 502 on Post Card

NEWS RELEASE

Union Tank Car Company, Chicago, Illinois

For Release: Immediately

Union Tank Car Company, Chicago, announces that Graver Water Conditioning Co. has become a completely integrated and wholly owned division of Union Tank, effective Jan. 1.

E. A. Locke, Jr., President of Union Tank Car Company, stated there will be no basic change in policy or method of operation of its new division, which will be known as Graver Water Conditioning Co., Division of Union Tank Car Company.

"We are devoting special attention to the expansion of Graver's research and development program in the vital and growing water conditioning industry," Locke stated.

H. T. Sulcer will continue as Vice President and General Manager of Graver Water Conditioning Co., a position he has held for the past nine years.

Th

May we call this Announcement to your attention...

As a practical matter, these combined assets make available to you the largest resources in our industry committed to an intensive program of chemical research and engineering development. This program will continue, on an expanded scale, to be a fundamental part of the Graver Water Conditioning Co. policy in developing creatively engineered equipment designs and products for the Utility, Industrial Power and Nuclear Industries.

For the past 50 years, our belief in research and development has been instrumental in pioneering the products that assure the ultra-pure feedwater and condensate required for the progressive evolution of higher pressure steam generators.

We believe that continued progress of our industry can only be accomplished through dedicated chemical and engineering research. Extensive laboratory and pilot plant studies are just two of the many phases of activity in our program of continued service to you.

For more data circle 503 on Post Card

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PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

TOOL ENGINEERS, members of ASTE, will have their annual meeting in Philadelphia Convention Center, May 1–8. Nearly 500 industrial exhibits will be on view, showing the latest in production equipment, machines, machine tools, accessories, processes, services and aids. Tooling for Competition is the theme for both show and conference. Two special symposia will be offered, one on Numerical Control, the other on Tooling for Metal Powder Parts. There will also be a Metal-Cutting Review seminar.

ASTE has expanded its International Education Awards program to include 22 scholarships for engineering students interested in pursuing tool and production engineering as a profession. The 40,000-member Society annually sponsors a $7000 scholarship program for college and university students. This year a $5000 award program will be initiated for technical institute and two-year junior college students.

STEAM ROARING right out of the ground is being harnessed as New Zealand's newest source of electric power. This geothermal steam exists at high pressures under the crust of earth in the volcanic belt of the North Island and manifests itself in numerous steam vents and semi-active volcanoes. A project is now underway at Wairakei to harness this force to drive generators.

This project is designed to provide New Zealand with 69,000 kw of power initially, 20,000 kw being scheduled for June. Today there are more than 40 bores in the Wairakei area, going down to depths of from 500 to 3000 feet, which roar into the atmosphere the equivalent of 50,000 to 60,000 kw. The deafening noise of the bores is silenced by a series of concrete pipes of increasing dimension attached to the bore outlet.

Pressures at the head vary between 70 and 200 psi when discharging steam, and bores of up to 8-in. diam are used. Tests have not shown any evidence yet of changes in the steam quantity or quality, and it seems that the power sources are dependable.

There have of course been technical difficulties. As the steam coming from the bores contains large quantities of water, special equipment has had to be designed to provide dry, pure steam to the turbine generators.

Estimates thus far of geothermal steam in New Zealand indicate a total power potential of about 250,000 kw.

IMPORTANT DATA on physiological effects of thermal exposure are given in a recent set of four papers from ASME's semi-annual meeting at San Francisco last year. These papers, with their numbers, are as follows:

Heat Transfer and Safe Exposure Time for Man in Extreme Thermal Environment, by Konrad Buettner (57-SA-20); Histologic Studies of Some Reactions of Skin to Radiant Thermal Energy, by J. R. Hinshaw (57-SA-21); Measurement of the Heating of the Skin During Exposure to Infrared Radiation, by E. Hendler, R. Crosbie and J. D. Hardy (57-SA-33); Body Cooling and Hand Cooling, by J. P. Meehan and H. I. Jacobs (57-SA-34).

RESOURCES FOR THE FUTURE, a 90-page report covering 1957, is available from the organization of that name, at 1145 Nineteenth St, NW, Washington 6, D. C. Established in 1952 under the wing of the Ford Foundation, Resources for the Future, Inc, works to advance the development, conservation, and use of natural resources, primarily in the United States, through programs of research and education. Chairman is Horace M. Albright. Director is Reuben G. Gustavson.

The present report includes chapters on water resources, energy and mineral resources, land use and management, regional studies, resources and national growth, resources education.

FRANKLIN C. MACKRELL, vice president of Stone & Webster Engineering Corp and district manager of the company's Chicago office, has been elected a director. Stone & Webster recently completed the design work on a 275,000-kw power station extension for Commonwealth Edison Co in the Chicago area.

MacKrell was first with Stone & Webster from 1922 to 1924, as an engineer in the structural division. In 1940 he rejoined the company as district manager in Washington, and was made manager of purchases in Boston in 1947, vice president in 1949. He has been district manager in Chicago since 1955. MacKrell is a member of the Association of Management Engineers and a member of the executive council of the American Society of Naval Engineers.

HIGHEST ELEVATOR in the whole West, just about, is being installed by Otis Elevator Co. This one is miles from city skyscrapers, deep in a canyon in California's Sierra Nevada mountains. It's part of the Haas Powerhouse installation of Pacific Gas & Electric Co, which is the country's first large-scale underground hydroelectric plant.

Otis' elevator will be the equivalent in height to one in a 40-story building, but it will have only ten stops, and, contrary to usual practice, the first trip will be down, 500 feet inside the mountain, the return trip being up. The two generating units of the Haas plant will produce 128,000 kw.

1687 REASONS WHY it pays American industry to invest more in American Standards are outlined in a new booklet just published by the American Standards Association. The 1687 reasons are the 1687 American Standards approved by ASA in almost every field of the American economy. Other points: without American Standards codes, electrical products would not have the national free market that has made possible their mass production, mass distribution, low cost, and high quality; it would cost an individual company thousands of dollars to develop two standards which it can buy from ASA for $4.50.

MEETINGS THIS MONTH: American Welding Society's annual conference and exposition, at Kiel Auditorium and Hotel Statler in St. Louis, April 14–18. In Chicago at the same time, April 14–17, the Design Engineering Show will be presented at the International Amphitheatre. Concurrently with this show, ASME will conduct a design engineering conference.

JOHN F. TOBIN, Western Regional Manager, American Blower Division of American-Standard, Chicago, will deliver an address on Selection and Application of Fans on May 5, 1958, in Minneapolis, before a meeting of the Minnesota Chapter of the American Society of Heating and Air Conditioning Engineers. His address will be based on technical fan data he presented under that same title in a series of four articles in POWER ENGINEERING in the January, March, May and September, 1954, issues. They were each 2-page articles and Mr. Tobin packed more specific technical data into them than you will find in many longer articles and books. He will have reprints of the articles available at the meeting.

MOVE-UPS came the other day for three top executives at Dayton Power and Light Co. Frank M. Tait was named honorary chairman of the board. Kenneth C. Long became chairman of the board. James M. Stuart was named president and general manager. Stuart started with the company as a co-op student from the University of Cincinnati in 1923.

TVA has begun preliminary site work at the Widows Creek Steam Plant in northeastern Alabama, for the construction of a 500,000-kw generating plant. This huge unit was authorized by TVA's board of directors last fall. Labor force at the project is expected to be about 550 by July, to reach a peak of 1200 by July, 1959. Hendon R. Johnston is project manager.

WORLD WITHOUT LIMIT — for the would-be electrical engineer — is well presented in a new booklet published by AIEE, 33 W 39th St, New York 18, N. Y. Titled The Indispensable Man, this attractive publication is addressed to the high school student who has strong leanings to science and mathematics, and gives guidance on how to approach a career in electrical engineering.

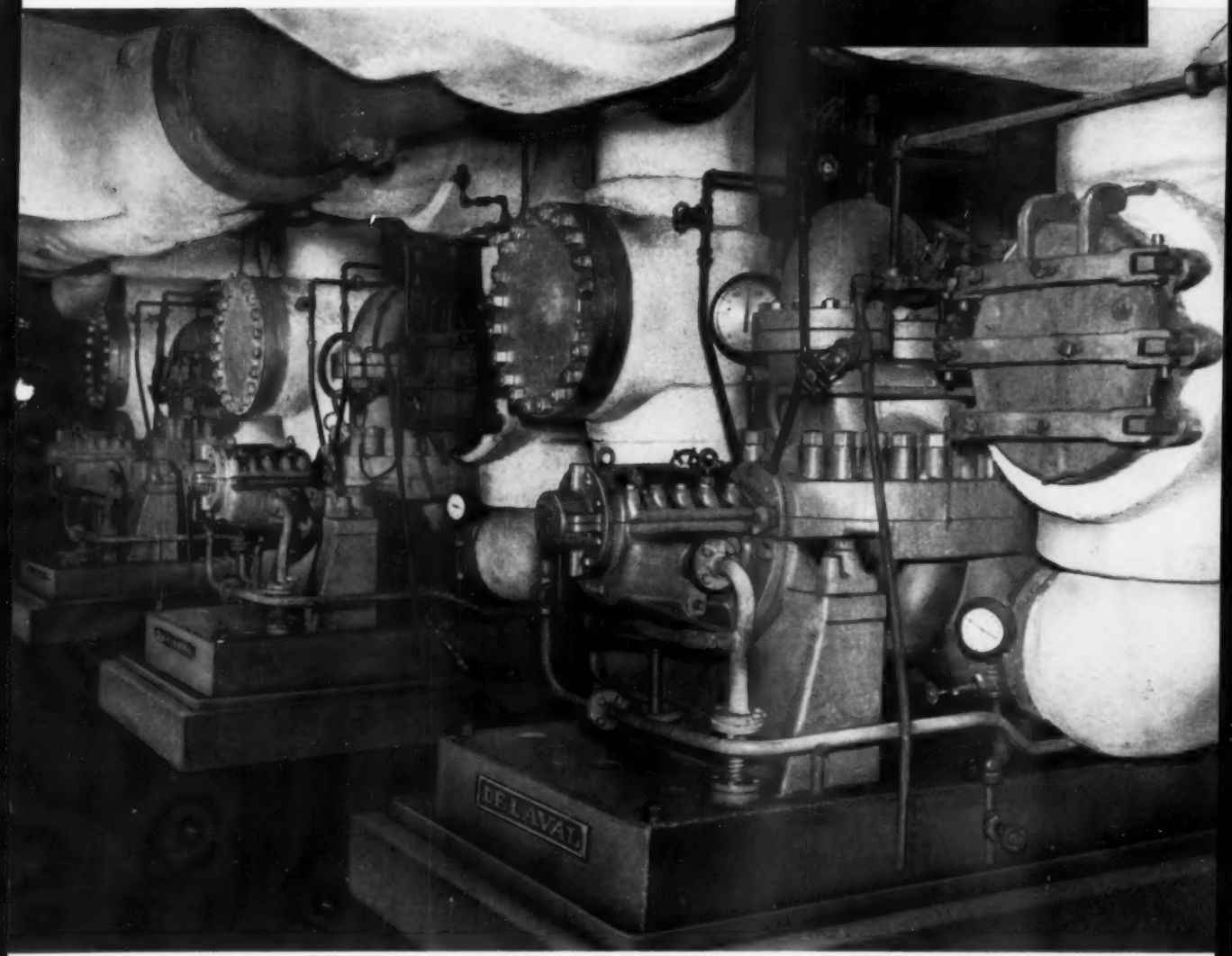
RUSSIAN technical journal, the bi-monthly *Journal of Applied Mathematics and Mechanics* (usually known in Russia as PMM), will soon be translated into English on a regular basis by ASME. Project will be financed by a $35,000 grant from the National Science Foundation. Publication begins with the first 1958 issue, and George Herrmann of Columbia University will serve as editor of the translated magazine. Copies will be sold on a subscription basis at an annual rate of $35 for the six issues. ASME members get a 20 per cent discount rate. Order from ASME, 29 W 39 St, New York 18, N. Y.

UNDERSTANDING ECONOMICS is something everybody wishes he had more of, these days. So news of Edison Electric Institute's employee course on economic fundamentals is appealing. The Institute's course is called The American Economic System and is designed to be given as a six-month program by company conference leaders in one-hour-a-month classes for employee groups. Teaching tools used include colored filmstrip, demonstration materials, leader's manual, and an illustrated 96-page book written by Edwin Vennard and Robb M. Winsborough.

Con Edison *reorders*

DE LAVAL

BOILER FEED PUMPS



The three De Laval Oppeller Pumps, shown in the photograph, do a dependable job of handling boiler feedwater at the East River Station of the Consolidated Edison Co. of New York. These three-stage pumps, with double-suction in the first stage, have a capacity of 2,000 gpm and operate at a discharge pressure of 620 psig. As proof of their reliable performance, Con Edison has ordered two identical units for the expansion of this station *plus* similar pumps for their Indian Point nuclear generating station.

Excellent for *medium* pressure and temperature service, De Laval Oppeller Pumps are designed with opposed impellers that balance axial thrust. Standard design features include sleeve bearings and labyrinth wearing rings which assure long economical service.

For *high* pressure, *high* temperature boiler feed service, De Laval offers the barrel-type pump . . . a single-suction, radially split diaphragm type multi-stage pumping unit inside a forged steel barrel.

For more data on these dependable pumps, write for Catalogs 1502 and 1506

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

816 Nottingham Way, Trenton 2, New Jersey

DL 413

WHAT THEY TELL US

▶ **OUR JANUARY ISSUE,** with its special section reviewing world power developments, draws this comment from Gerson Chanin, chief sanitary chemist with East Bay Municipal Utility District, Oakland, Cal.:

> I should like to compliment you, especially, for the very excellent material presented in the January issue, which was, in my opinion, even better than the usually fine job that you do.

▶ **HOLLOW FLAGPOLE** used for the dispersion of digester gas from a sewage disposal plant was described in POWER ENGINEERING in April, 1957. This description has stimulated Roy R. Robinson, city manager of Kinston, N. C., to share with us this interesting account of wastes disposal and water supply in Charlevoix, Mich. Robinson writes:

> This [hollow flagpole] design feature was used a long time ago, in a plant built in 1935 and located in the heart of a small town. It has occurred to me and undoubtedly to others, that engineers, in their desire to produce the latest in modern design, sometimes neglect what has been done in the past.
>
> This sewage plant of which I speak was designed for and constructed in the resort city of Charlevoix, Mich., which is located on the shore of Lake Michigan about 50 miles below the Straits of Mackinac. The city is unique in having Round Lake in the center of the corporate limit and connected with Lake Michigan on one side and Lake Charlevoix on the other. Round Lake is used as a marina and has extensive boat yards.
>
> Prior to the construction of the sewage disposal plant, all of the city's waste was discharged to Round Lake and the flow of water between the two large lakes was depended on for dispersal. The State sanitation commission issued a cease and desist order in 1933 but construction was not started until 1935 when statutory authority was given for the issuance of revenue bonds. The revenue from the sale of the bonds, plus a PWA grant, financed the construction.
>
> This plant was designed by Greeley and Hansen of Chicago, and has a capacity of a half million gallons per day, four-hour detention period. The space above the settling tanks was utilized for the office, laboratory, chlorine room and screen room with the digester connected by a garage and shop. Digested sludge is hauled away by a tank truck to a drying area outside the city. Plant is located on the shore of Round Lake in a park in the center of the business district and about 200 ft from the main street. The louver-topped, hollow flagpole is the digester vent. Gas with oil is used for heating in winter.
>
> Construction of this plant must have been a considerable undertaking and certainly was accomplished in an excellent manner. The settling tanks were dewatered in 1955 for the replacement of some flights, and there was no sign of settling or leakage. An interesting letter was received in April, 1955 from William E. Stanley, Professor of Sanitary Engineering at Massachusetts Institute of Technology, in which he stated that he had designed the plant while working with the consultants, and that he wished to know the condition and operating results. J. C. Marshall has operated the plant from the start-up, and it is due to his meticulous housekeeping that the plant looks so good today and has operated so well.
>
> Also in Charlevoix is an interesting water supply system designed about 1922 by the firm of Shoecraft, Drury and McNamee of Ann Arbor, Mich. This plant was built on the shore of Lake Michigan and utilized two concrete collection galleries roofed over with redwood plank leading into a circular well. The galleries are about 20 ft under the beach elevation and form a natural sand filter. The supply seems unlimited and is of good quality. As can be seen, this far outdates the Ranney System, which it somewhat resembles. This idea was used in recent years when a city diverted the flow of a river and constructed a gallery in the stream bed for water collection, afterwards turning the flow back to the original.
>
> No doubt many such unusual designs have been used and it is unfortunate that they are not available for study. The designing firms would have them, of course, but such information could be more widely disseminated. The ideas and practices used in construction are probably lost forever.

Fig. 1. Sewage disposal plant in Charlevoix. Flagpole is the digester vent

Fig. 2. Round Lake, in center of city, connects Lakes Michigan, Charlevoix

In commenting on the whole problem of water supply and wastes disposal, Robinson points out that there is a tremendous job ahead for engineers. Industrial processes are taking more water and creating more toxic wastes, and these problems complicate plant location as well as operation of existing plants. He continues:

> It is not difficult to envision a closed cycle where sewage effluent is introduced back into plant process. In our dryer areas the waste of millions of gallons of sewage effluent is a little alarming. When water is taken from a supply source, then treated, softened, demineralized and used for a domestic supply, then wasted back to a stream, it would seem only sensible to think that this water could be treated in sewage plant and reused for industrial process; or, for that matter, for potable supply. It is pure from a complete treatment plant.
>
> Some use along these lines has been accomplished, but a lot more study is indicated. Too few people realize that water is one of our most important resources, and take it for granted until the well runs dry. Larger plants seem to study the problem, but the small operator is too busy with more pressing problems.

▶ **HOSPITAL ENGINEERS** are a group all their own in the complex of interests that makes up the American Hospital Association, with headquarters at 18 E Division St, Chicago. F. O. Howard, chief of maintenance of Fairview State Hospital in Costa Mesa, Calif., asks for information on AHA's Council on Hospital Planning and Plant Operation. We looked into the situation, find that this group is composed of hospital engineers who are members of the Personal Membership Dept for Hospital Engineers. One of the services is a Hospital Engineers' Newsletter. Man to contact is G. A. Weidemier, at the address above.

"And for extreme pressure and temperature there is a heavy duty Armstrong"

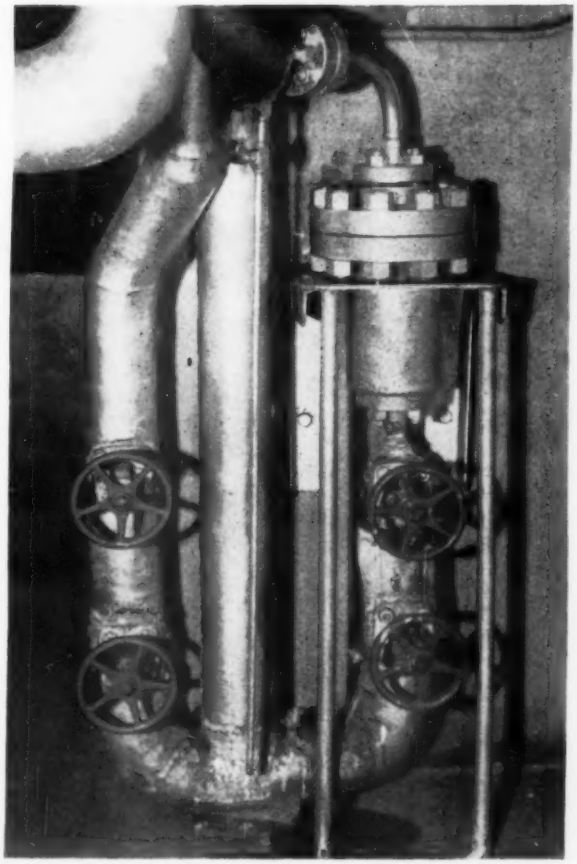
Reproduction of Armstrong Trap advertisement which appeared in power magazines in 1924.

Armstrong steam traps have grown up with the increase in steam pressure that started right after World War I. Forged carbon steel bodies made their debut in 1929 with carbon moly and chrome moly steels following as pressures went up.

The traps listed below have forged carbon steel bodies and caps for service to 600 psig, 750F.; carbon moly or chrome moly to 900 psig, 900F.; chrome moly to 2500 psig and temperatures above 900. Valves and seats heat treated chrome steel or Stellite. Other working parts are 18-8 stainless except the bucket weight.

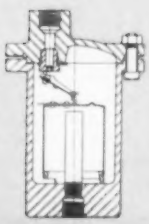
COMPLETE DATA in 44 page CATALOG J, free on request. Call your local Armstrong Factory Representative or write:

ARMSTRONG MACHINE WORKS
3105 Maple St., Three Rivers, Michigan

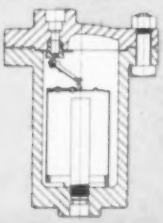


No. 515 Armstrong flanged trap at central station—dependable protection of superheated steam lines.

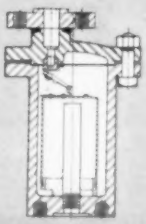
SCREWED, SOCKET WELD AND FLANGED CONNECTIONS



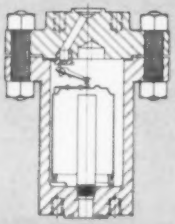
Screwed ⅛" to 2"—pressures to 900 lbs.



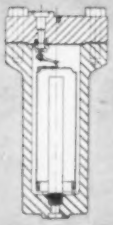
Socket weld ½" to 2" pressures to 900 lbs.



Flanged connections —½" to 2" pressures to 900 lbs.



No. 515 trap—socket weld or flanged 1" or 1¼"—pressures to 1500 lbs.



No. 615 trap—socket weld or flanged 1" or 1¼"—pressures to 2500 lbs.

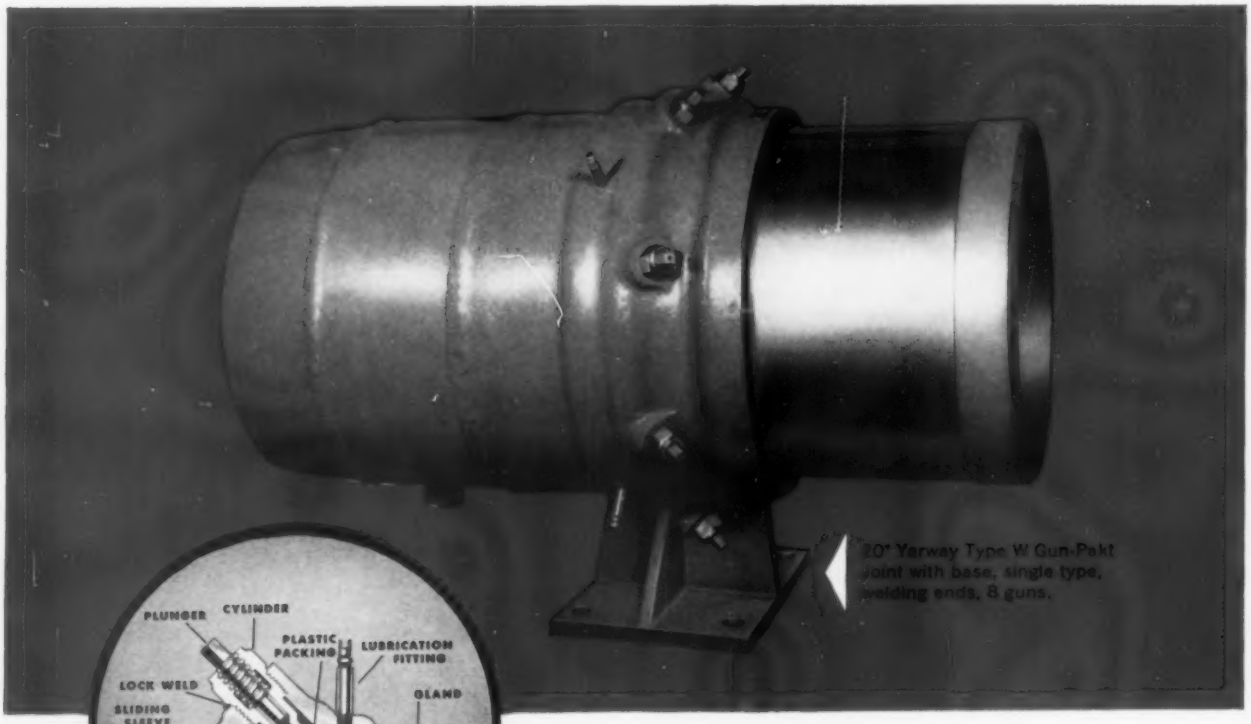
ARMSTRONG INVERTED BUCKET FORGED STEEL **STEAM TRAPS**

For more data circle 505 on Post Card

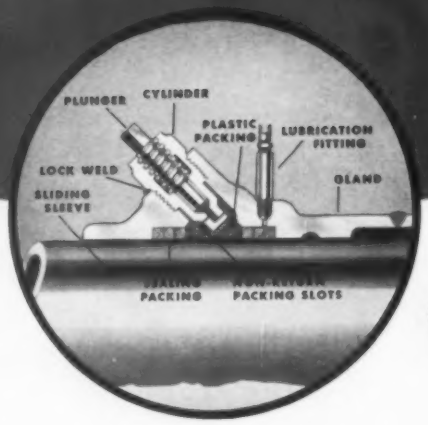
new savings

for expansion joint users...

YARWAY TYPE W GUN-PAKT



20" Yarway Type W Gun-Pakt joint with base, single type, welding ends, 8 guns.



Cross-section of Gun-Pakt feature. To add packing, just add a plug and turn the plunger. Note non-return packing slots at bottom of cylinder.

YARWAY® GUN-PAKT

The Yarway Type W Gun-Pakt Expansion Joint has an improved one-piece design of body and gland and improved method of packing that provide new maintenance economies and greater operating efficiency.

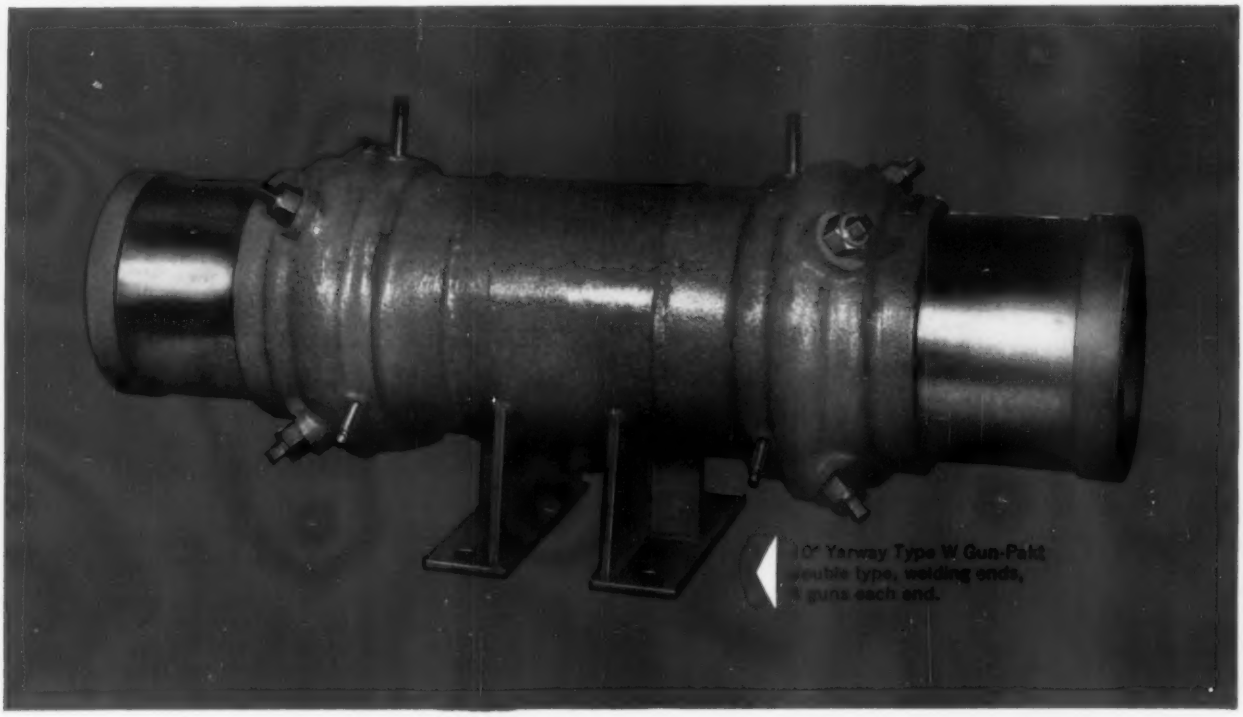
Bolted joint between body and gland is eliminated; the steel body includes gland and guide. Shorter face-to-face dimensions are possible. Improved angle of packing guns makes them more accessible and *permits injection of the special plastic packing directly into packing space.*

The famous Yarway *Gun-Pakt* feature permits *addition of packing under full steam pressure. No need for costly shutdowns to repack.*

Sizes 1½" to 30", pressures 150, 300, 400 psi. Single or double types, flanged or welding ends.

For full description, write for new Yarway Bulletin EJ-1916.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



TYPICAL GUN-PAKT EXPANSION JOINT USERS

PUBLIC SERVICE & MUNICIPAL

Detroit Edison Co.
Georgia Power Company
New England Gas & Electric Corp.
Pacific Gas and Electric Co.
Philadelphia Electric Co.
Rochester (N.Y.) Gas & Electric Co.
Toledo Edison Co.
Wisconsin Electric Power & Light Co.

INSTITUTIONS & GOV'T BLDGS.

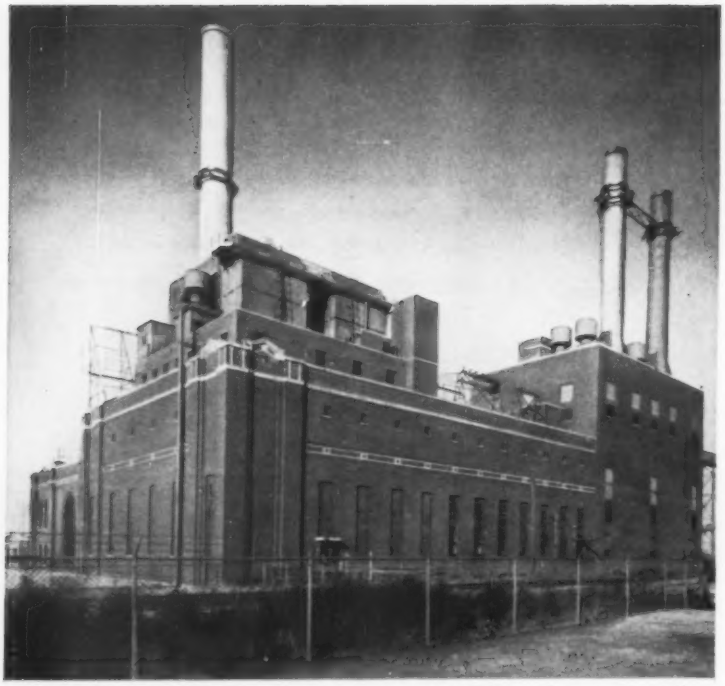
Boston State Hospital
Central Heating Plant, Washington
Massachusetts Institute of Technology
McGill University
Ohio State University
University of Chicago
University of Kansas
University of North Carolina

INDUSTRIAL PLANTS

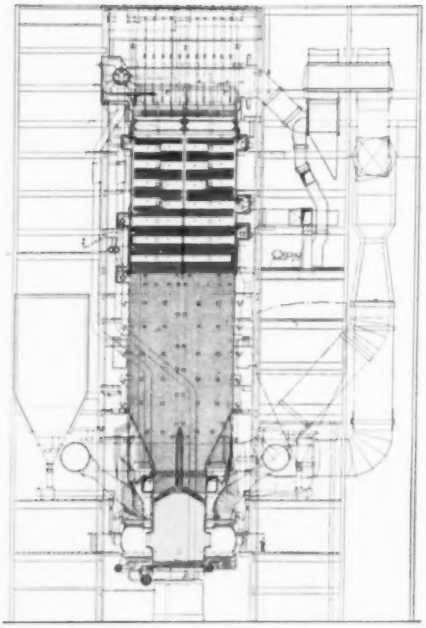
Carbide & Carbon Chem. Corp.
Dow Chemical Corp.
Ford Motor Co.
General Electric Company
General Motors Corp. (Buick Div.)
Procter & Gamble Co.
Socony Vacuum Co.
Union Bag & Paper Co.

...a good way to specify expansion joints

For more data circle 506 on Post Card



On the line for eight years at Commonwealth Edison Company's Joliet Station, 2 B&W Cyclone Furnace Boilers produce 1,200,000 pounds of steam per hour.



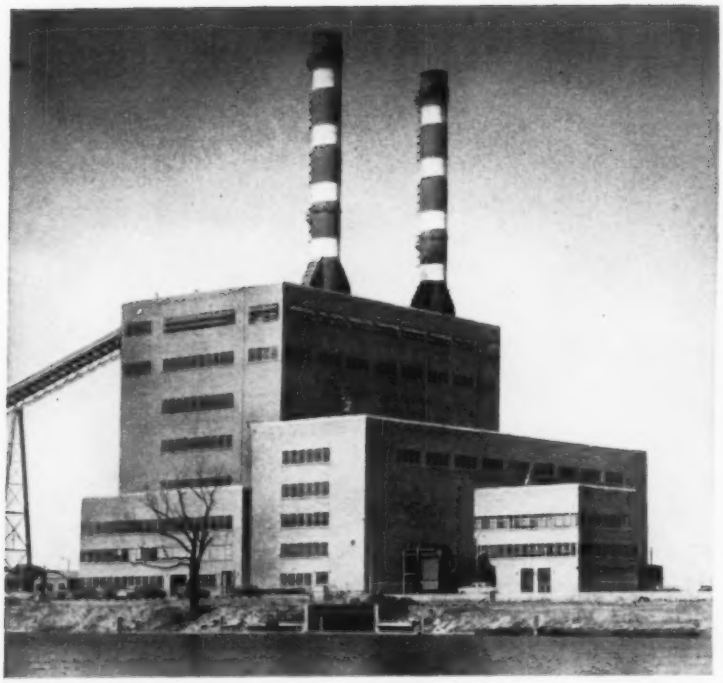
New Cyclone Furnace unit under construction for Joliet Station will generate 2,200,000 pounds of steam per hour. It will burn highly volatile Central Illinois coal with a high ash content and low ash-fusion temperature.

Proof in Action Means Continued Acceptance for B&W Cyclone Furnaces

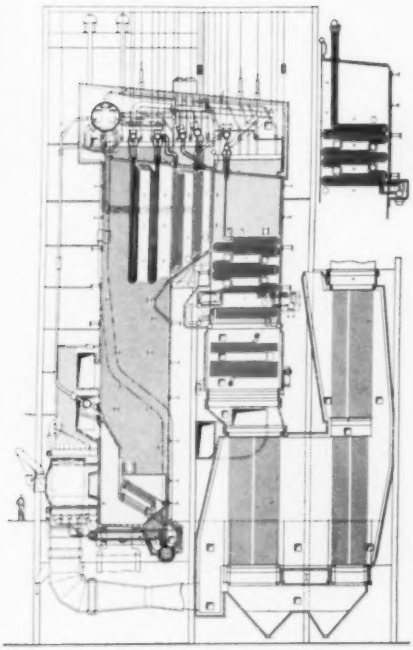
ON-LINE UNITS PROVIDE MODERN MEANS OF BURNING FUEL ECONOMICALLY

In installation after installation, the efficiency, economy and simple operation of B&W Cyclone Furnaces have led to continued acceptance. At the Commonwealth Edison Company, where the first Cyclone Furnace was installed in 1944, 14 additional units are in operation with still another on order. And at Wisconsin Power and Light Company's Edgewater Station, a Cyclone-Fired Boiler achieved such an outstanding record that B&W Cyclone Furnaces were also specified for that Company's Rock River and Nelson Dewey Stations.

The B&W Cyclone Furnace simplifies the entire process of coal preparation, combustion, ash handling and ash segregaton. Its cost-saving quality contributes to lower fuel costs and re-



Rock River Station of Wisconsin Power and Light Company. Six B&W Cyclone Furnaces fire 2 B&W Boilers to produce 1,050,000 pounds of steam per hour.



New unit for Wisconsin Power and Light's Nelson Dewey Station will use a B&W Cyclone Furnace to fire boiler producing 700,000 pounds of steam per hour.

duced maintenance as well as increased operational simplicity, flexibility and safety. Recognition of these facts is attested by the 77 Cyclone Furnace Boilers now either in service or under construction throughout the country.

Many other modern advances in combustion and high-pressure, high-temperature steam generation are also available through B&W. They merit examination in connection with your next installation. Write for further information to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

PURCHASERS OF THE B&W CYCLONE FURNACE

FOR CENTRAL POWER STATIONS	Number of Cyclone Furnace Boilers
Atlantic City Electric Co.	1
Baltimore Gas & Electric Co.	1
Chilena de Electricidad	2
Columbus & Southern Ohio Electric Co.	2
Commonwealth Edison Co.	16
Consumers Public Power District (Nebraska)	1
Detroit Edison Co.	1
Indiana & Michigan Electric Co.	1
Jersey Central Power & Light Co.	3
Memphis Light, Gas & Water Division	3
Middle South Utilities, Inc.	1
Missouri Public Service Company	2
Monongahela Power Co.	1
Northern Indiana Public Service Co.	3
Ohio Edison Co.	2
Ohio Power Co.	6
Public Service Co., of New Hampshire	1
Tampa Electric Co.	3
United Illuminating Co.	2
Wisconsin Power & Light Co.	4
FOR INDUSTRIAL INSTALLATIONS	
American Cyanamid Co.	1
American Enka Corp.	1
Clinton Corn Processing Co., Division of Standard Brands	1
Columbia Southern Chemical Co.	1
Consolidated Water Power & Paper Co.	1
Dow Chemical Co.	5
Eastman Kodak Co.	1
Greenwood Mills	1
International Paper Co.	4
National Container Corp., of Wisconsin	1
Rhinelander Paper Co.	1
St. Croix Paper Co.	1
Thilmany Pulp & Paper Co.	1
West Virginia Pulp & Paper Co.	1
Total	**77**

BABCOCK & WILCOX

BOILER DIVISION

G-887

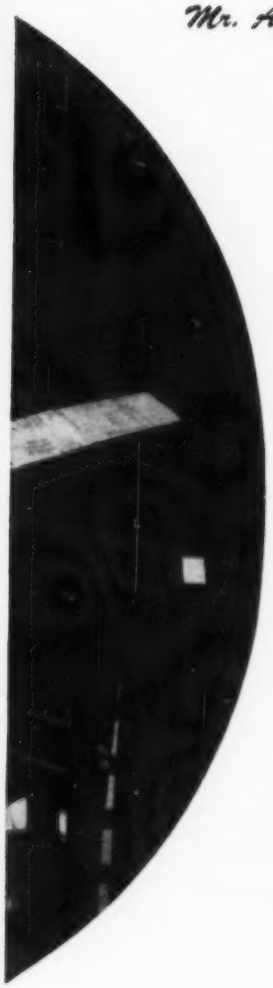
For more data circle 507 on Post Card

MR. EDWARD ACKERMAN
THE MANHATTAN SHIRT CO.

Fusetron dual-element fuses protected 150 motors against burnout when a hurricane single phased our primary line

MR. EDWARD ACKERMAN
CHIEF ELECTRICIAN-THE MANHATTAN SHIRT CO.
PATERSON, NEW JERSEY

Mr. Ackerman continues . . .



"One afternoon a hurricane struck and single phased the line feeding our plant.

"At the time, all 150 of our sewing machines were in operation. No one suspected the motors were running single phase. Our first warning came when the machines started shutting down through the plant as Fusetron fuses began blowing to protect the motors.

"I had no idea in what condition we would find the motors. It was certainly a relief when we checked and did not find one damaged sewing machine motor. Around 300 Fusetron fuses had blown to protect them.

"You can imagine how costly it would have been to repair or replace these ½ hp., 3 phase, 220 volt motors — and our plant would have been out of business while this work was being done. So we think we paid a very small price when our only expense was replacing the 3-2/10 ampere Fusetron fuses.

"Since this experience, our seven other plants have been informed of the above incident, and it has been suggested to them, that they protect all sewing machine motors with Fusetron dual-element fuses."

Why Fusetron fuses provide safest, simplest way to prevent damage from single phasing.

When single phasing occurs, the current in the remaining phase increases about 100%. (Theoretically 73% but change in efficiency and power factor makes it about 100%.

This 100% overload on Fusetron fuses of motor-running protection size opens them and shuts down the motor.

Such dependable protection against motor burnouts from single phasing has never before been available.

You too, can get maximum electrical protection and save money by installing Fusetron dual-element fuses throughout the plant

With rare exceptions on commercial and industrial installations — ordinary fuses and circuit breakers protect only against short-circuits — but Fusetron dual-element fuses provide 10 point protection.

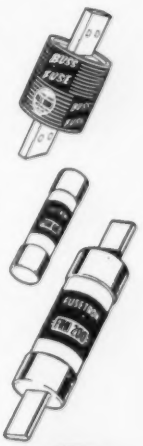
FOR LOADS ABOVE 600 AMPS. — USE BUSS HI-CAP FUSES TO COORDINATE YOUR ELECTRICAL CIRCUITS.

On 600 volts or less, BUSS Hi-Cap fuses have interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuits of origin.

FOR MORE INFORMATION ASK FOR BULLETIN FIS ON FUSETRON DUAL-ELEMENT FUSES — BULLETIN HCS ON BUSS HI-CAP FUSES.

BUSSMANN MFG. DIVISION
McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.



FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Play Safe! install FUSETRON dual-element FUSES and BUSS Hi-Cap FUSES throughout entire Electrical System!

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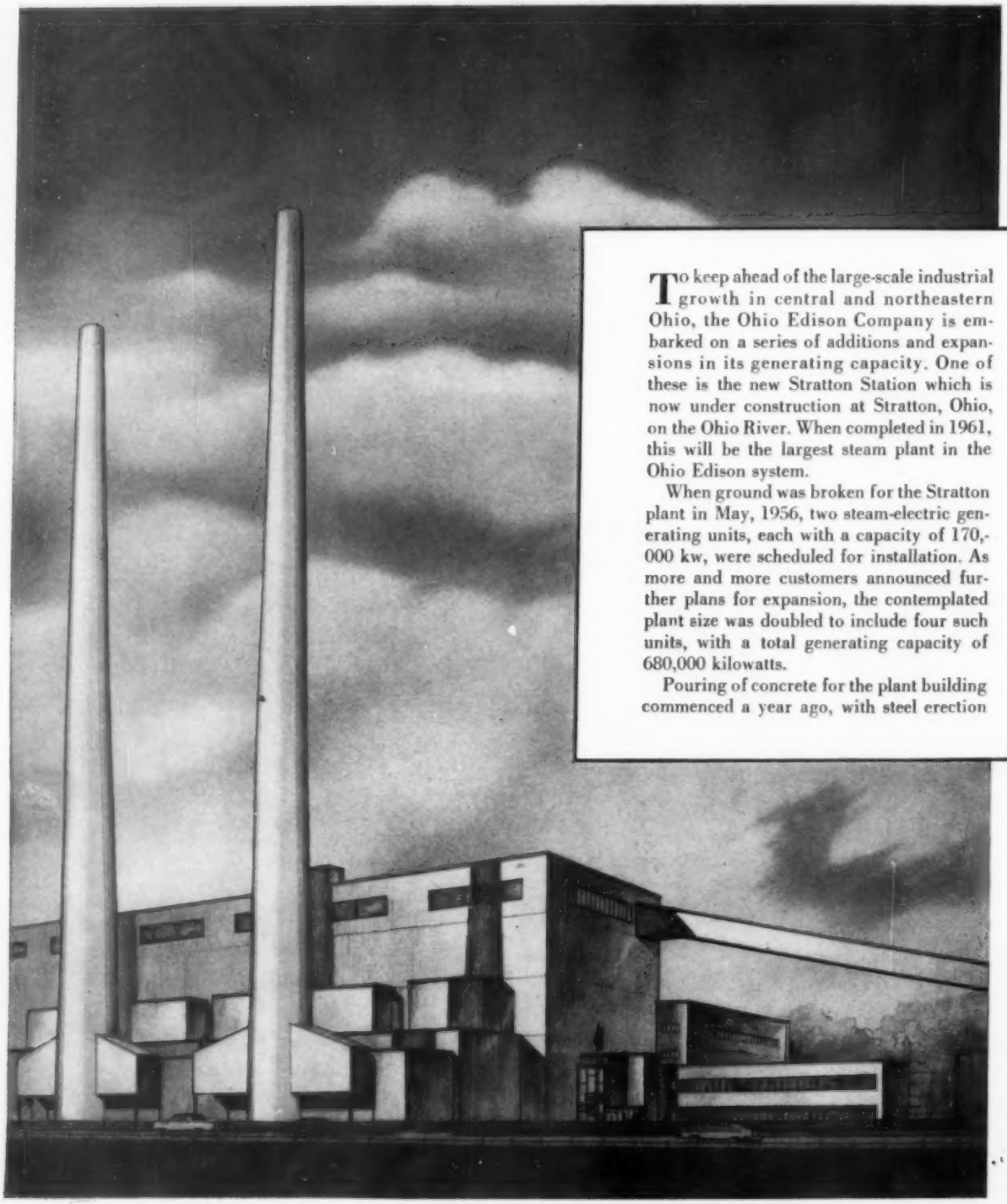
At Ohio Edison's
FOUR FW STEAM GENERATORS



To keep ahead of the large-scale industrial growth in central and northeastern Ohio, the Ohio Edison Company is embarked on a series of additions and expansions in its generating capacity. One of these is the new Stratton Station which is now under construction at Stratton, Ohio, on the Ohio River. When completed in 1961, this will be the largest steam plant in the Ohio Edison system.

When ground was broken for the Stratton plant in May, 1956, two steam-electric generating units, each with a capacity of 170,000 kw, were scheduled for installation. As more and more customers announced further plans for expansion, the contemplated plant size was doubled to include four such units, with a total generating capacity of 680,000 kilowatts.

Pouring of concrete for the plant building commenced a year ago, with steel erection

Largest Plant,

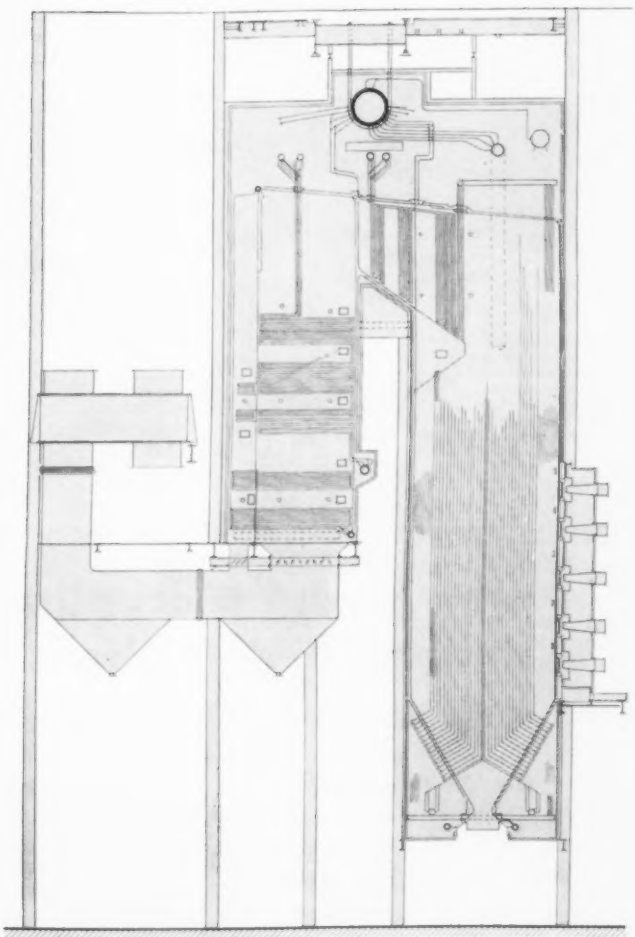
will deliver 5,000,000 lb/hr

New Stratton Station, now under construction, will have capacity of 680,000 kw by 1961 — with four 170,000 kw units, each served by a FW 1,250,000 lb/hr Reheat Steam Generator

beginning last August. The first turbo-generating unit is scheduled to go into service late this year — the second next year, the third in 1960 and the fourth in 1961.

Steam for all units at Stratton Station will be supplied by four Foster Wheeler reheat steam generators with a combined capacity of five million pounds per hour. Each of these FW boilers will have a normal capacity of 1,250,000 lb/hr at a pressure of 2450 psig (2700 psig design) and a temperature of 1050 F at the superheater outlet. The reheat flow will be 1,040,000 lb of steam per hour at 430 psig and 1000 F.

With more than a half-century of experience in steam generation — and the finest modern manufacturing facilities in three large plants — Foster Wheeler welcomes the opportunity to quote on your requirements. *Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.*



Architect's conception of the completed Stratton Station plant of Ohio Edison. Ground was broken for the plant in May, 1956. When the last of four units is installed at Stratton Station in 1961, it will have the largest capacity in the Ohio Edison system.

Cross section of reheat steam generator for Ohio Edison's Stratton Station. Four of these units have been ordered for the 680,000-kw plant. Each unit will supply 1,250,000 lb of steam per hour at 2450 lb/sq in. pressure, 1050 F primary steam temperature and 1000 F reheat temperature.

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

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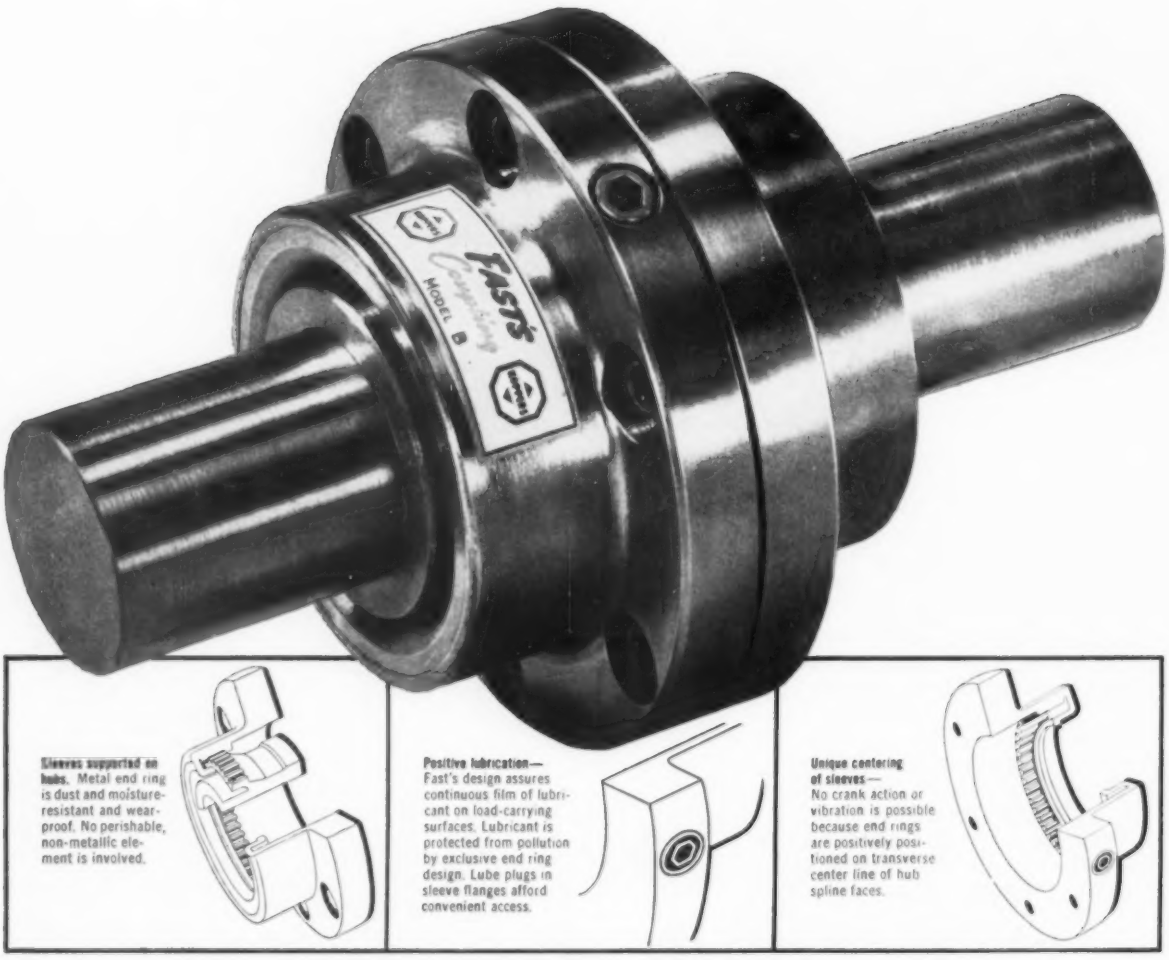

Sleeves supported on hubs. Metal end ring is dust and moisture-resistant and wear-proof. No perishable, non-metallic element is involved.

Positive lubrication— Fast's design assures continuous film of lubricant on load-carrying surfaces. Lubricant is protected from pollution by exclusive end ring design. Lube plugs in sleeve flanges afford convenient access.

Unique centering of sleeves— No crank action or vibration is possible because end rings are positively positioned on transverse center line of hub spline faces.

Fast's Model B coupling reduces downtime and upkeep for light-to-medium drives

Mechanical flexibility eliminates costly shutdowns and expensive shaft replacements. But—it's only one of many cost-saving features.

Now you can profit from the durability and economy of famous Fast's couplings in a smaller and lower-cost version—available in 5 sizes for shafts ½" to 3⅛" in diameter.

The Model B coupling gives you the same features that have made Fast's the world's leading coupling for over 35 years. You get the same trouble-free performance, longer service life and lower maintenance costs. You also get prompt delivery because stocks are on hand to meet practically every need. Free engineering service is also available.

Write today for more details to KOPPERS COMPANY, INC., Fast's Coupling Dept., 3704 Scott Street, Baltimore 3, Md.

Engineered Products
Sold with *Service*

KOPPERS

THE ORIGINAL
FAST'S Couplings

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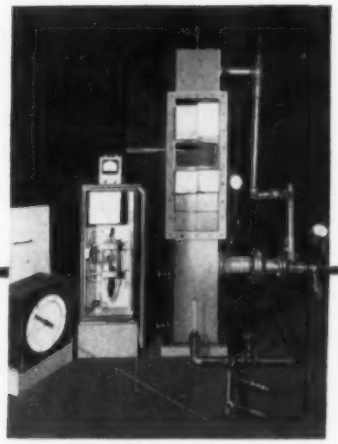
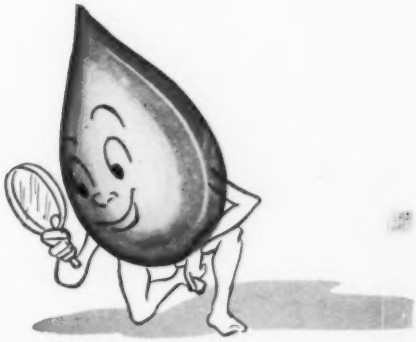
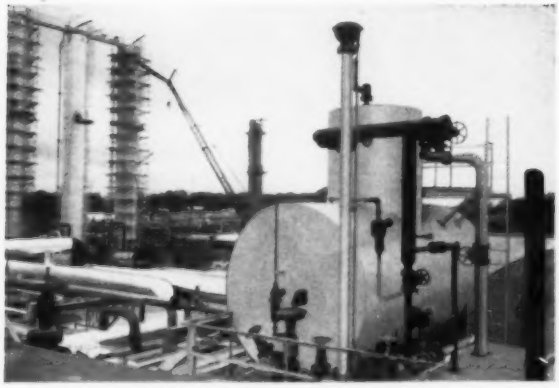


Pilot tray-type deaerator shown with continuous oxygen analyzer in test setup.

ALLIS-CHALMERS DEAERATORS



Looking for more effective deaeration?



Outdoor installation of Allis-Chalmers deaerator in southern chemical plant.

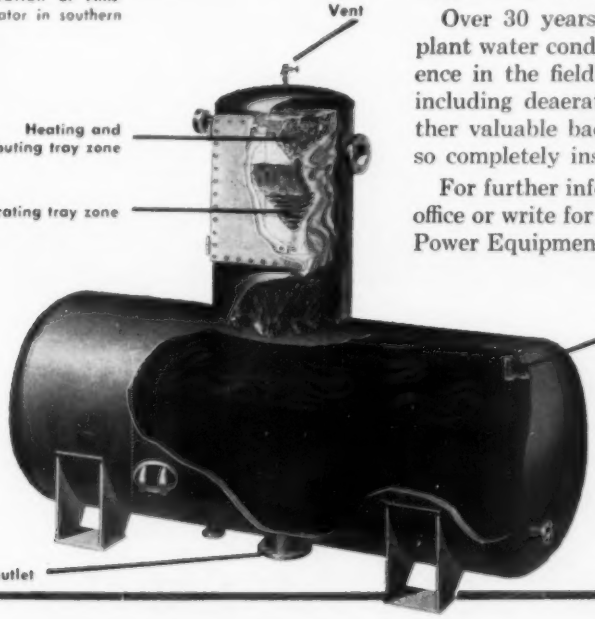
● If so — you'll be interested in the continuing research program at Allis-Chalmers to evaluate all factors in the design of deaerators.

This program includes the use of a specially built pilot deaerator with automatic oxygen analyzer and recorder. Operating factors and deaerating compartment design can be varied to study length of spilling edge of trays, heating area and method of flow. Results obtained with this setup are quickly translated into deaerators designed for optimum performance.

In addition to this continuous testing, metallurgical research is being done to select the most suitable materials.

Over 30 years' experience in the field of power plant water conditioning, and over 75 years' experience in the field of steam power plant equipment including deaerating-type condensers, provide further valuable background. No other manufacturer so completely insures deaerator performance.

For further information contact your nearby A-C office or write for Bulletin 28B8853, Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.



Cross section of tray-type deaerator shows water and steam flow.

ALLIS-CHALMERS

A-5674

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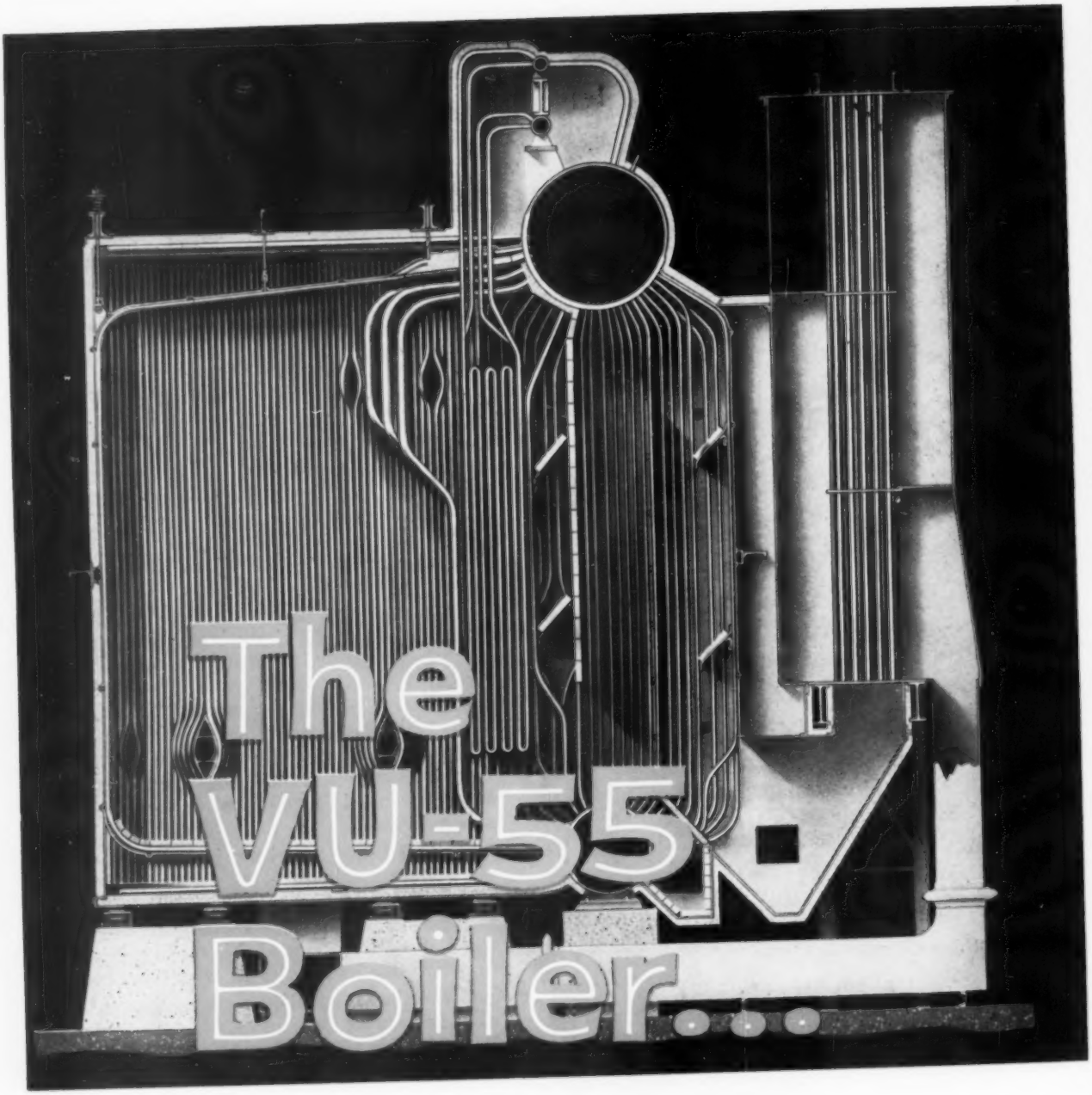
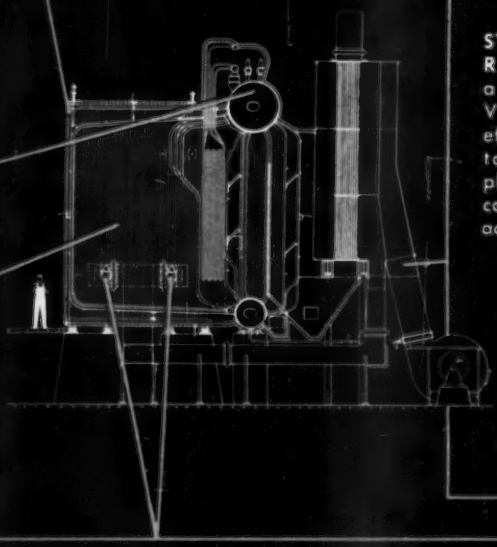


Custom Features, Standard Sizes, Advanced Design

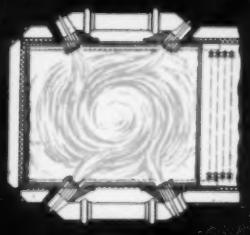
DOUBLE WALL, PRESSURE-TIGHT CASING. The latest development in casing construction for pressure firing of boilers in the size class of the VU-55, this casing is designed to assure life-time tightness with minimum heat loss. Pressure firing permits the elimination of an induced draft fan with its attendant operating and maintenance costs. Construction consists of tangent tubes backed up successively by welded steel panels, 4 inches of high quality insulating material and an outer steel casing formed as shown to provide adequately for expansion and assure ample strength. Low heat loss and the tightness required for pressure firing are assured by this double-wall construction.

HIGH STEAM QUALITY. Equipped with a large (60-in.) steam drum, the VU-55 has generous water capacity and steam reservoir space. C-E drum internals assure high quality steam at all ratings.

TANGENT FURNACE TUBES. The VU-55's furnace tube arrangement provides complete heat-absorbing, water-cooled protection on all furnace walls. Furnace maintenance is minimized, refractory expense is eliminated, heat absorption rates per sq. ft. are higher.



STREAMLINED EXTERIOR. The over-all appearance of the VU-55 reflects the efforts of its designers to achieve a completely unobstructed casing, while retaining adequate access wherever required and every facility for convenient operation. There are no outside downcomer tubes, and the ducts from air heater to burners are beneath the furnace floor.



TANGENTIAL FIRING. More than 20 years of application experience have established the exceptional advantages of tangential firing. About 90 percent of Combustion's large utility installations use this advanced method of firing. Flame streams from the four burners impinge upon one another at high velocity, as shown, creating a turbulence unattainable by any other method of firing. The result is rapid and complete combustion. As the gases spiral upward, they sweep all furnace heating surfaces, assuring a high rate of heat absorption.

The VU-55, newest of the C-E line of Vertical Unit Boilers, represents the closest approach to central station performance yet achieved in standardized boilers in its capacity range.

Its design combines a number of time-tested and service-proved features, such as Tangential Burners, double wall, pressure-tight casing, and tangent furnace tubes. In addition, this bottom-supported unit requires no outside supporting steel, is economical of space and streamlined in appearance.

It is available in 5 sizes for capacities from 50,000 to 120,000 lb per hour. It is designed for 3 pressure ranges (250, 500 and 750 psi) and can be equipped with a superheater to provide temperatures up to 750 F. Either a tubular or a regenerative air heater is available.

The VU-55 Boiler is symmetrical in design, performs efficiently over a wide range of output, and is easy to operate and maintain.

It is, in fact, the boiler with the custom features and the advanced design.

COMBUSTION ENGINEERING

B-978

Combustion Engineering Building

200 Madison Avenue, New York 16, N. Y.

Canada: Combustion Engineering-Superheater Ltd.

all types of steam generating, fuel burning and related equipment; nuclear reactors; paper mill equipment; pulverizers; flash drying systems; pressure vessels; soil pipe.

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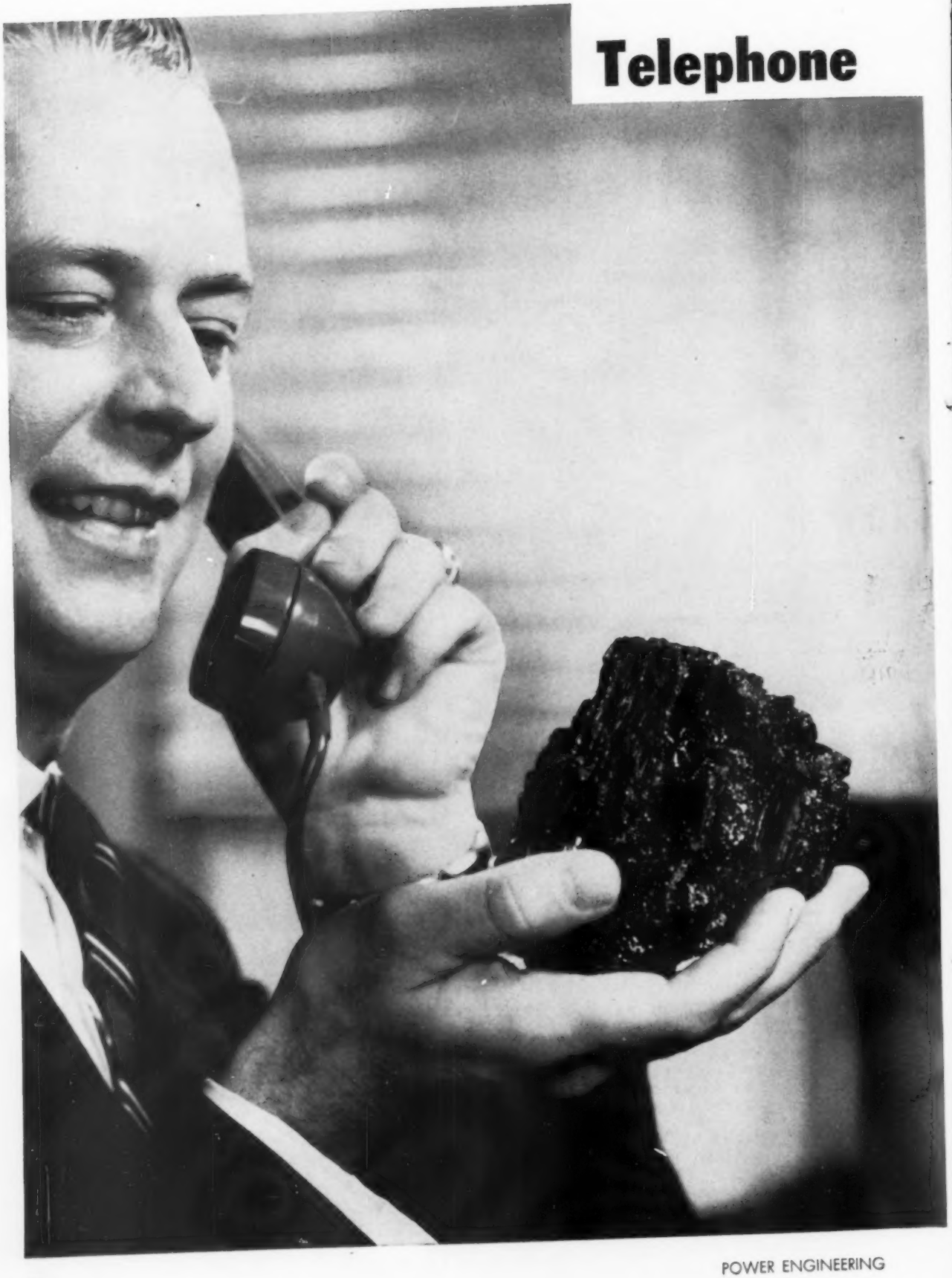

Telephone

manufacturer calls for coal

Automatic Electric Co. burns coal in new plant because of cost and availability

Modern facilities, modern products, modern fuel—you'll find all three at the new Northlake, Ill., plant of Automatic Electric Co., manufacturing subsidiary of General Telephone. The power house of this communications equipment plant (designed and built by The Austin Company of Cleveland) is as modern and efficient as the manufacturing process itself. The plant required large quantities of economically and reliably produced steam for process work and heating. The fuel selected was *coal*, because of coal's economy and abundant supply. As a result, today Automatic Electric enjoys dependable, low-cost steam.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas, as in the case of Automatic Electric, but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with industrial fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send the coupon below for case histories, complete with data sheets. You'll find them informative.

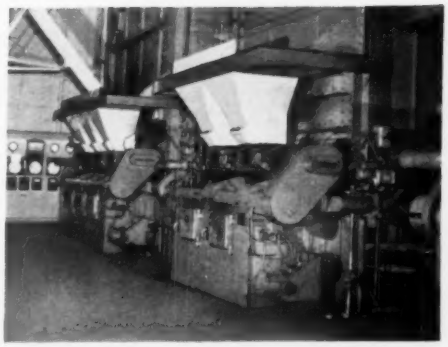
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

BITUMINOUS COAL INSTITUTE

Department PE-04

Southern Building • Washington 5, D.C.



Shown are two of the three Keeler boilers – fired by Detroit Spreader Stokers – in the power plant. At the right is the 22,000 lb/hr boiler. In the background is one of the 50,000 lb/hr boilers. The two sizes allow flexibility in operation for widely varying load requirements.

Control panel by Hays Corporation. This system regulates all operations of the boilers—steam pressure, draft, flue gas temperature, banking periods, etc.—to give complete, automatic control of steam generating operation.

Ash disposal system, by United Conveyor Co., in basement of boiler room. Ash is removed from furnace by Detroit CC grate, drops into hoppers in basement and is taken by vacuum to silo.

The Bituminous Coal Institute now has available a free booklet adaptable for design loads 3,000 to 24,000 EDR steam. This booklet, "Guide Specifications for Typical Low-Pressure Commercial Heating Plant," contains specifications, drawings and tables on all aspects of a typical heating plant. Send in this coupon for your copy.

☐ Guide Specifications Booklet ☐ Case histories on larger plants.

Name.....

Title.....

Company.....

Address.....

City..... Zone..... State.....

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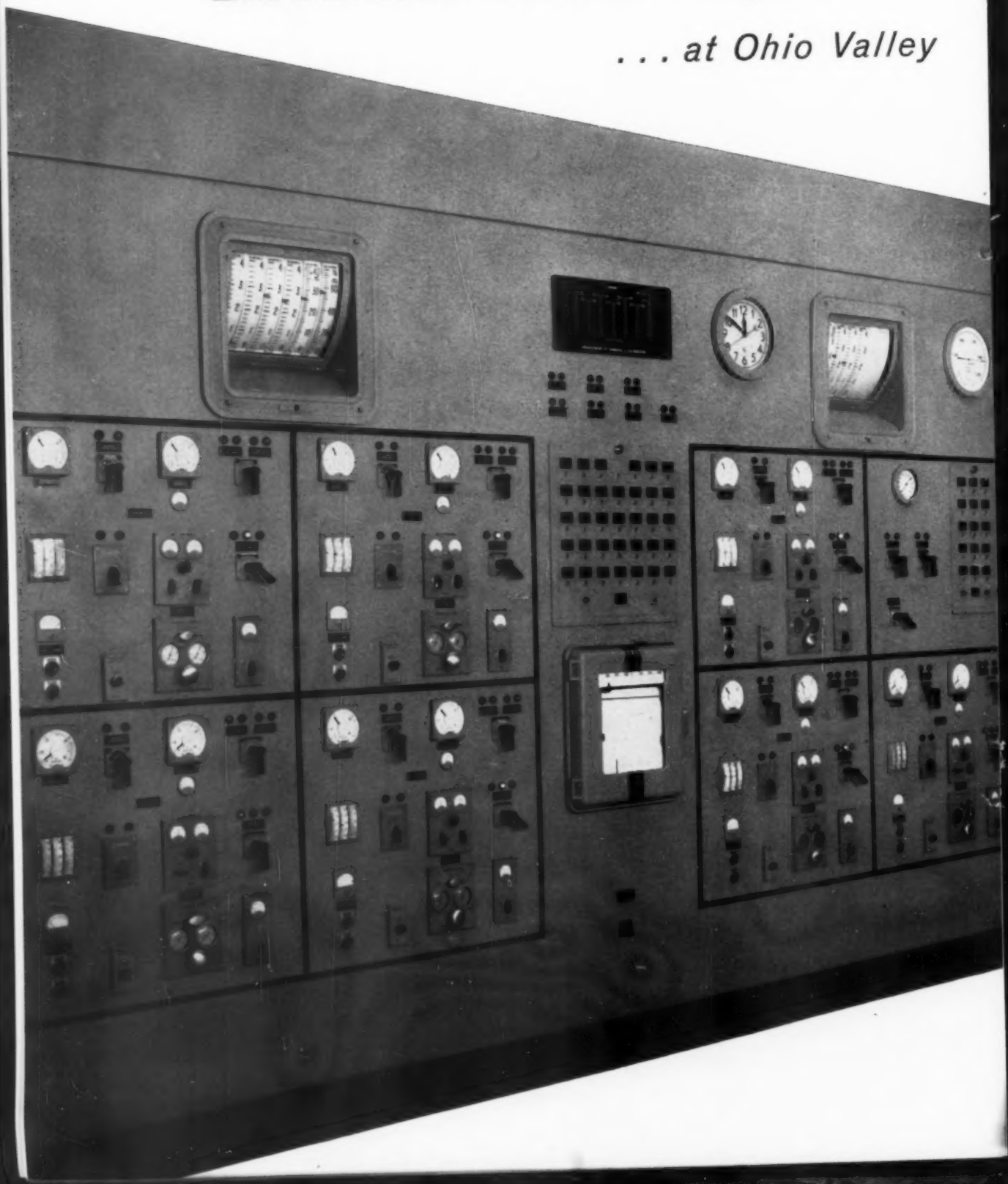
ANOTHER REPUBLIC ACHIEVEMENT!

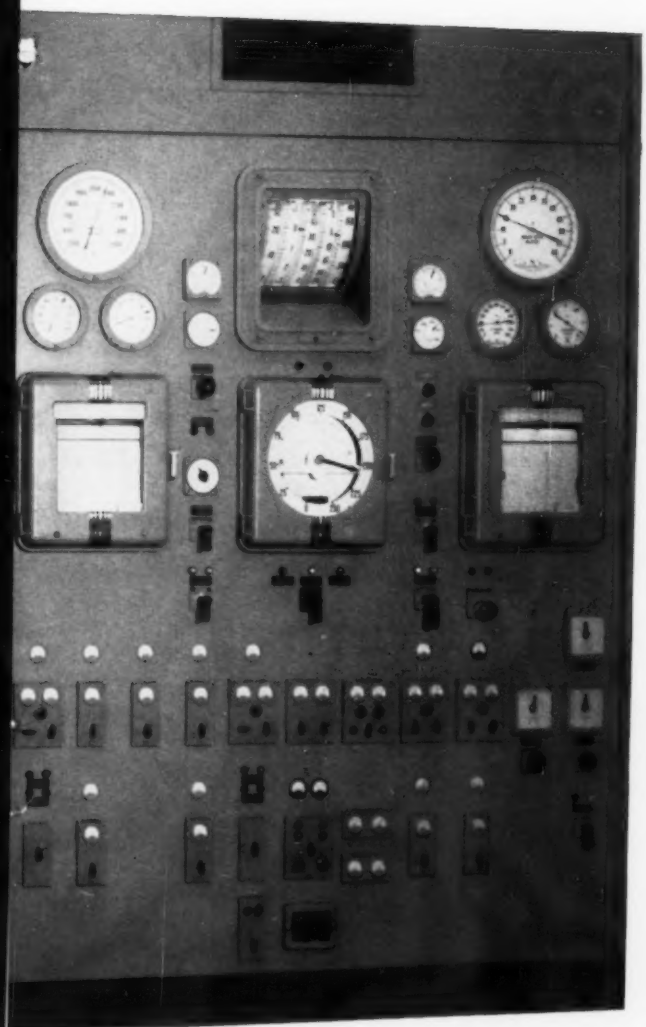
Electronic Master Systems

. . . at Ohio Valley



Control Five 1,400,000 lb/hr. Boilers

Electric Corporation's Kyger Creek Power Plant



One of Kyger Creek's five Republic control centers. An Electronic Master operates to provide electric signals for pneumatic power positioners on 7 coal pulverizers, 2 F. D. fans and 2 I. D. fans on each boiler.

Five large boilers in this plant produce a million kilowatts for our nation's atomic energy program. Multiple components on each boiler must work simultaneously as a single unit, in order to operate at maximum efficiency under all loads. A Republic *load-sensing* combustion control system with an Electronic Master regulates all these inter-related functions . . . counters every fluctuation in steam flow with corrected fuel and air flow settings without waiting for variations in steam pressure. An integral *pressure* control system makes final corrections in control signals (if necessary) to hold steam pressure constant.

Republic's experience with plants of all sizes, all pressure and temperature ratings, and all load characteristics is your best guarantee of getting all the premium performance built into your major equipment. A technically-trained, thoroughly experienced Republic Sales Engineer is ready to discuss your instrument and control problems. Republic sales offices are located in principal cities throughout the country.

REPUBLIC FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

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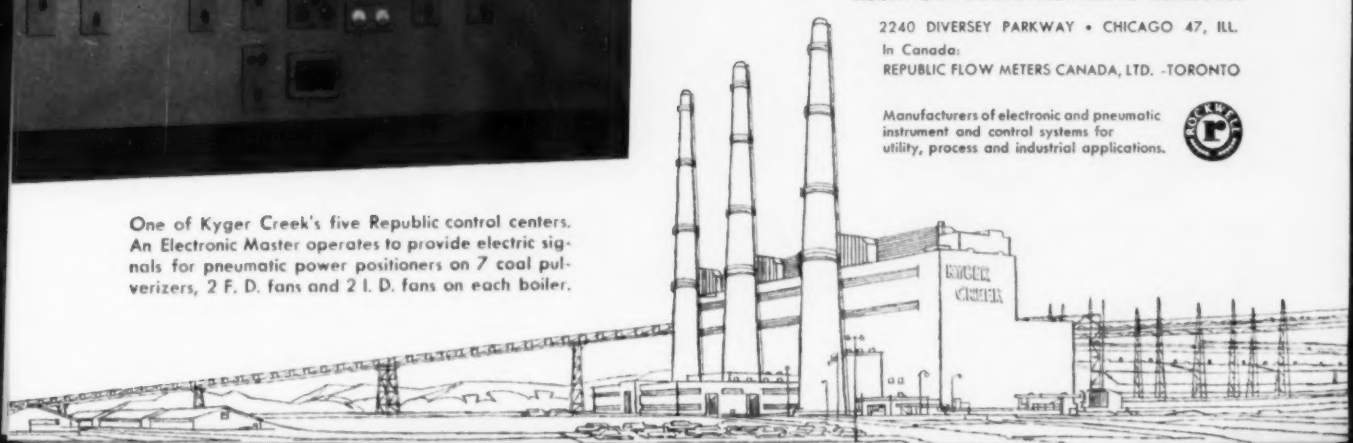
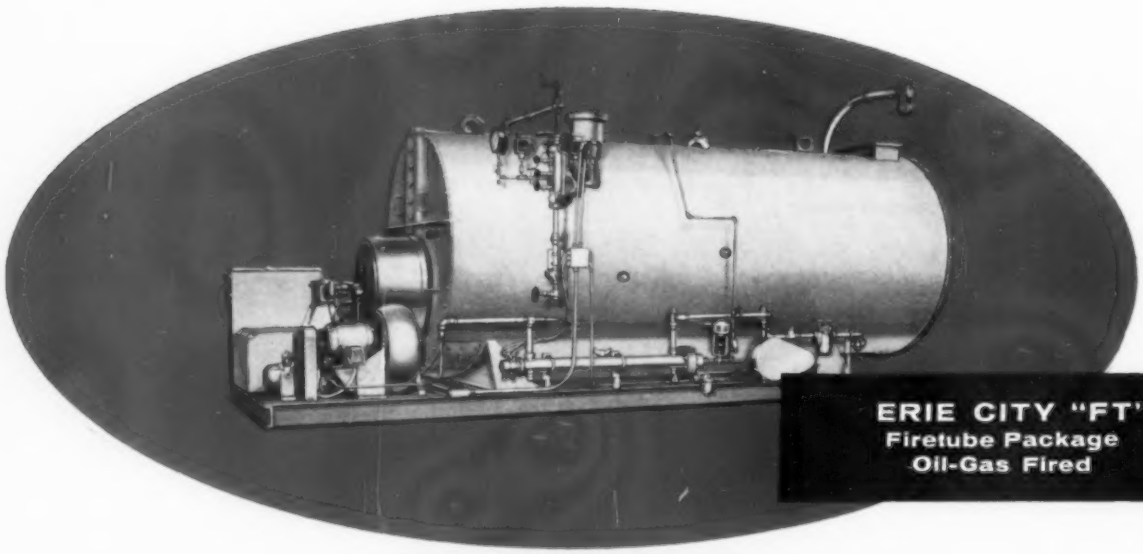
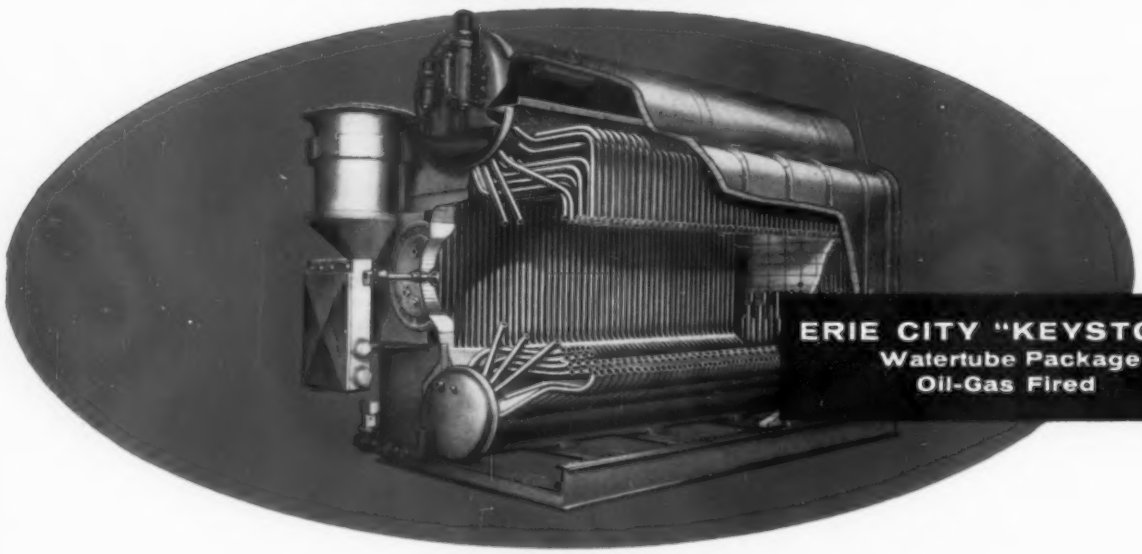
REPUBLIC FLOW METERS CANADA, LTD. -TORONTO

Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.

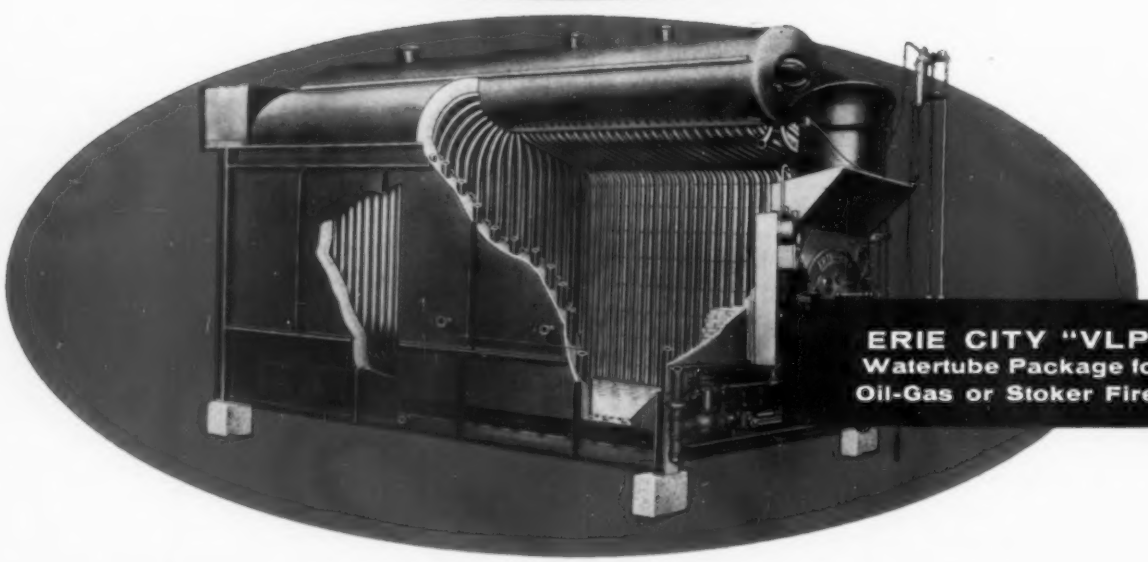




ERIE CITY "FT"
Firetube Package
Oil-Gas Fired



ERIE CITY "KEYSTONE"
Watertube Package
Oil-Gas Fired



ERIE CITY "VLP"
Watertube Package for
Oil-Gas or Stoker Fired

Why shop around for Package Boilers?

Thinking about a new boiler these days? Maybe a package boiler! Sounds like a good idea because many people like this new concept of undivided responsibility. But what kind should we get? Firetube? . . . Watertube? Should it be oil fired, gas fired, arranged for future stoker firing; or which combination of these would be best for us?

The best place to find unbiased answers to your questions is Erie City Iron Works—a pioneer in the boiler industry and a leader in the package steam generator field. Erie City manufactures both firetube and watertube package units. Without prejudice their engineers can point out the advantages of both types.

After hearing the pros and cons of each, you may decide on the firetube type. Erie City offers its modern "FT" Package Boiler arranged with Erie City air atomizing oil gun and/or ring type gas burner. The "FT" Fire Tube Package unit is built to highest quality standards—not down to a price. It is a three pass design with gas vent at the rear and pressurized, using forced draft to provide precise control of excess air and CO_2. A centrifugal fan is used, which coupled to a closed combustion chamber, results in unusually quiet operation. No costly foundation—no expensive stack—no brickwork are required.

If a watertube boiler is your choice, you have two types available from Erie City. One is the KEYSTONE, the most compact water tube package available, arranged with a steam atomizing oil gun and/or ring type gas burner. The KEYSTONE is a baffleless, two drum unit completely water cooled with a seal welded inner casing and bolted outer casing for pressurized operation. No costly foundation—no expensive stack—no brickwork are required.

The other choice for a watertube package is the VLP. Your plant may be located in an area where gas, oil and coal are all available. At first you may decide to fire with oil or gas but desire the proper provision for future coal firing. The boiler for you to install is an Erie City VLP arranged for present oil and gas firing but with the furnace PROPERLY PROPORTIONED for the future installation of an underfeed or spreader stoker.

All Erie City package units come complete with burners, fans and safety and combustion controls, piped, wired and mounted on the boiler. No field work required—just make basic fuel, water, steam and electric connections and you're ready for operation.

Both the air atomizing and steam atomizing burners are of Erie City's own design and manufacture. No division of responsibility here. Qualified service engineers will assist at start up and instruct your operating personnel. In the case of the VLP, your boiler will be properly designed for future conversion to either Erie City underfeed or spreader stoker firing. Again, no division of responsibility.

Don't let the selection of a new boiler become an unnecessary problem. Write and let Erie City help make the proper selection of a package steam generator for you.

"FT" *Cat.* SB5682D

"KEYSTONE" *Cat.* SB5982D

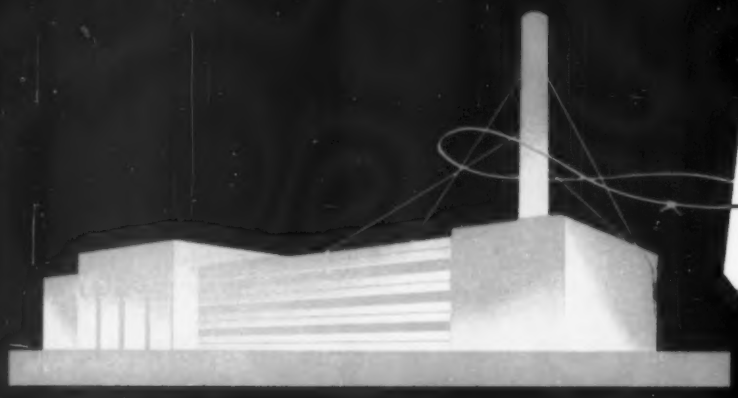
"VLP" *Cat.* SB5782D

• *You can depend on* ERIE CITY Since 1840 *for sound engineering*

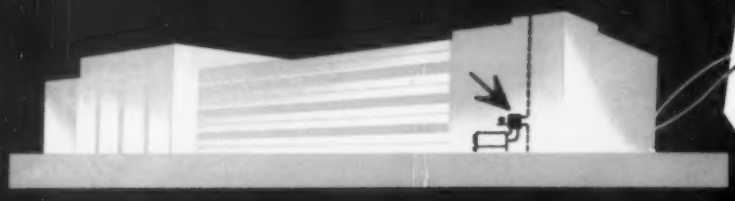
ERIE CITY IRON WORKS *Erie, Pennsylvania*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS • WASTE HEAT BOILERS
FIRE and WATER TUBE PACKAGE BOILERS • OIL and GAS BURNERS • STOKERS • PULVERIZERS

For more data circle 514 on Post Card



INSTALLED COST
$1,500.
STACK



INSTALLED COST
$900.
WING AUTOMATIC
DRAFT INDUCER

Wing

DRAFT INDUCERS Cost Less Cut Fuel Bills

Lower "installed cost" is the first advantage of Wing Draft Inducers. The figures shown above, taken from an actual installation, show how savings of over 25% are possible.

This is one reason expensive, ugly smokestacks have disappeared from today's modern, low buildings. Owners of older buildings, too, find that Wing Draft Inducers are less expensive than replacing tall smokestacks which have corroded or are in danger of falling.

In addition to lower "installed costs," Wing Draft Inducers also cut fuel costs by as much as 15%. These savings are the result of consistent, proper draft for complete fuel combustion. With Wing Draft Inducers you are not at the mercy of the weather for proper draft and complete combustion.

Another advantage is negligible maintenance. There's no tall stack to repaint every two or three years, no brickwork to point up or replace. Wing's design and construction, shown on the next page, have given years of reliable operation in thousands of installations.

For detailed information on how Wing Draft Inducers can give you Lower Installed Costs, Lower Fuel Costs and Reliable Operation, write for Bulletin 157.

OTHER WING PRODUCTS: Unit Heaters, Fresh Air Supply Heaters, Fans, Turbine and Motor Blowers, Auxiliary Turbines.

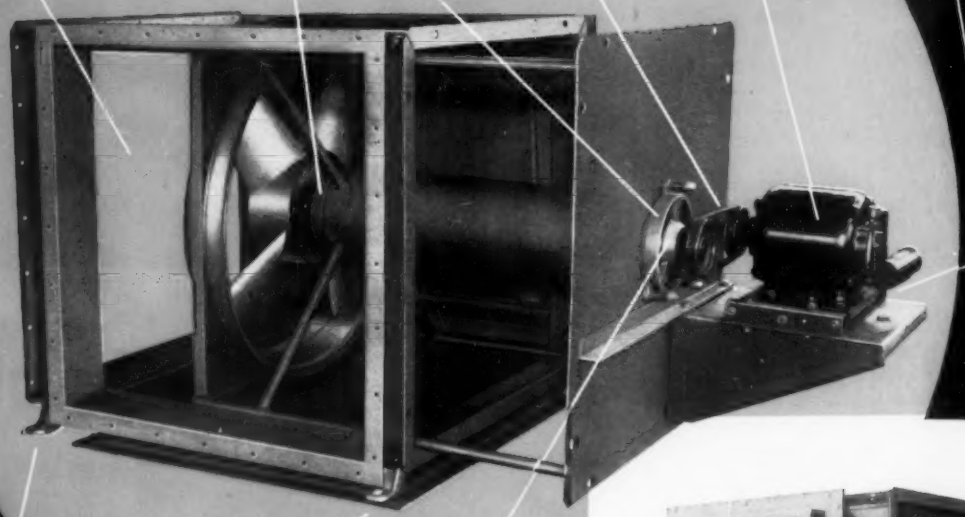
Entire fan and bearing assembly easily withdrawn from casing. All parts are then accessible outside the stream of hot gases.

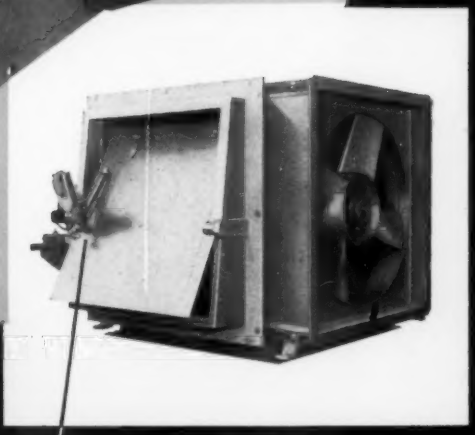
Precise draft control assured through variable speed motors.

V-belt drive eliminates need for field alignment.

Interchangeable Inlet Panels provide flexibility of installation. Assure most efficient use of boiler room space.

Belt tension automatically maintained by special spring-base mounting. No field adjustments necessary.





Mounting can be for either horizontal or vertical discharge by positioning four mounting feet.

No lubrication needed. Exclusive air cooling system keeps sealed bearings within few degrees of ambient.

Built-In Barometric Damper is optional.

For use with oil, gas, stoker or hand-fired heating boilers, industrial furnaces, kilns or high pressure steam boilers.

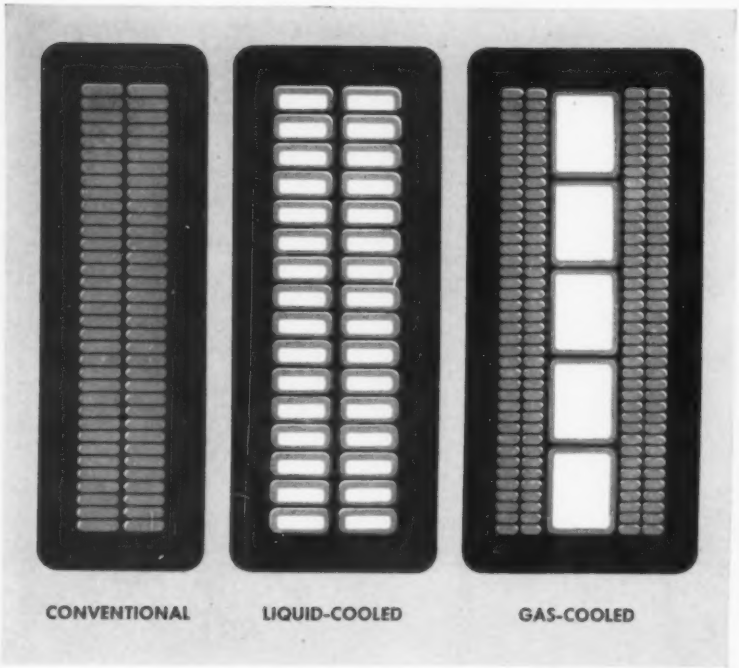
L. J. Wing Mfg. Co.

DIVISION OF AERO SUPPLY MFG. CO., INC.

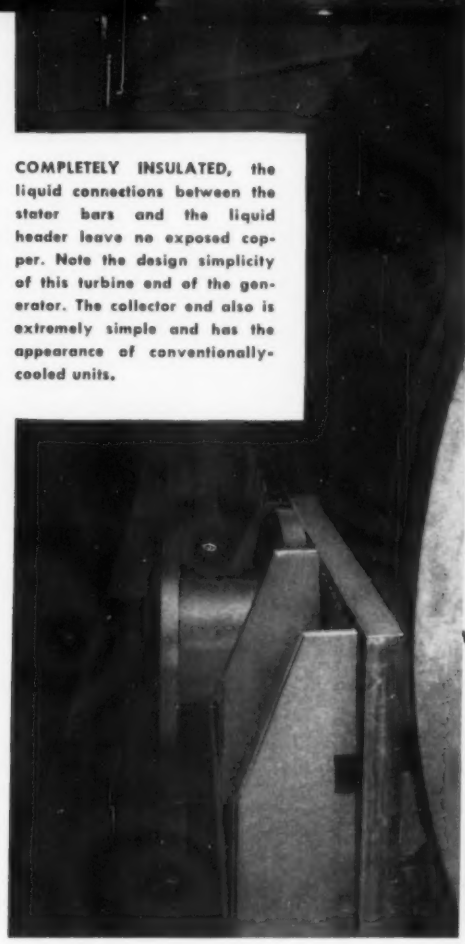
140 VREELAND MILLS ROAD, LINDEN, NEW JERSEY

FACTORIES: LINDEN, N. J. AND MONTREAL, CANADA

IN EUROPE: WANSON, HAREN-NORD, BRUSSELS, BELGIUM



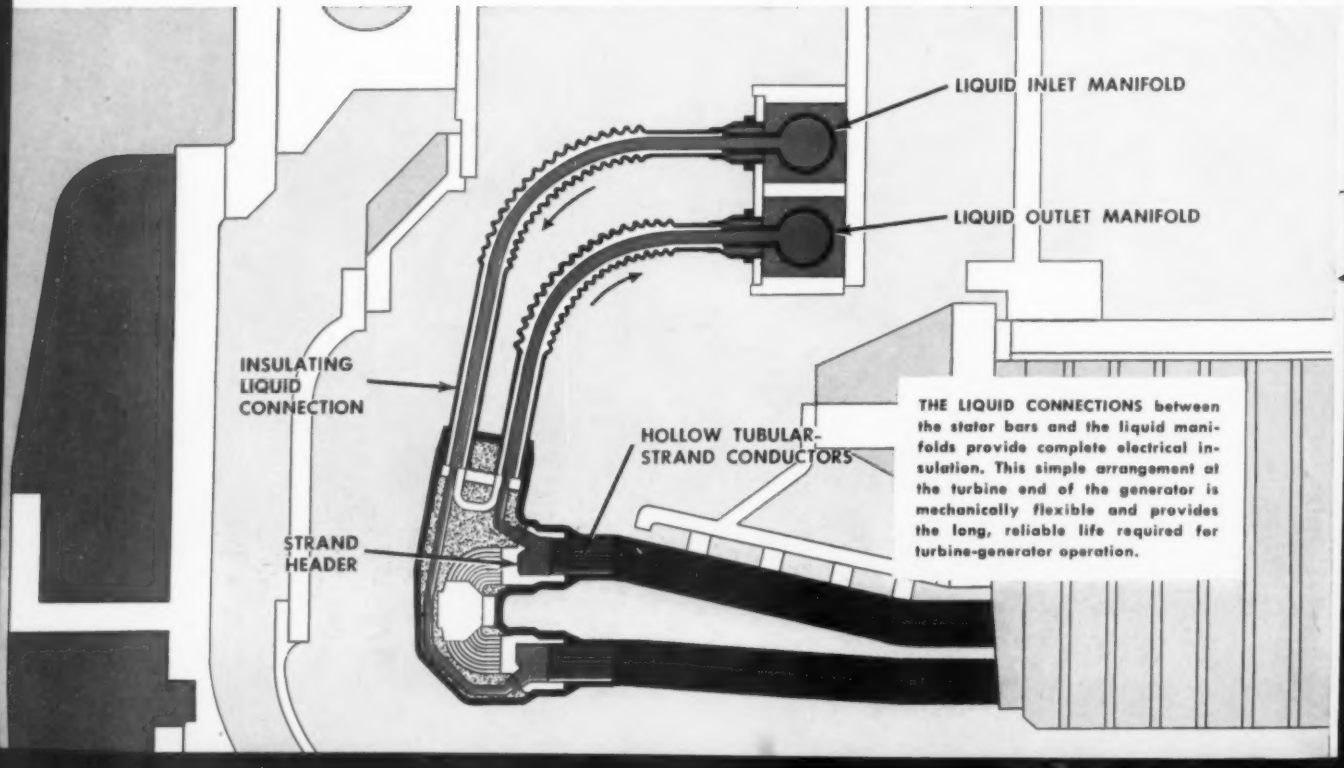
COMPARISONS of three types of stator bars built by General Electric show that dielectric construction of the liquid-cooled bar is as simple as for the conventional bar. Since liquid flows directly through the hollow conductors, no duct insulation is required as in the gas-cooled bar, and heat transfer is considerably improved.



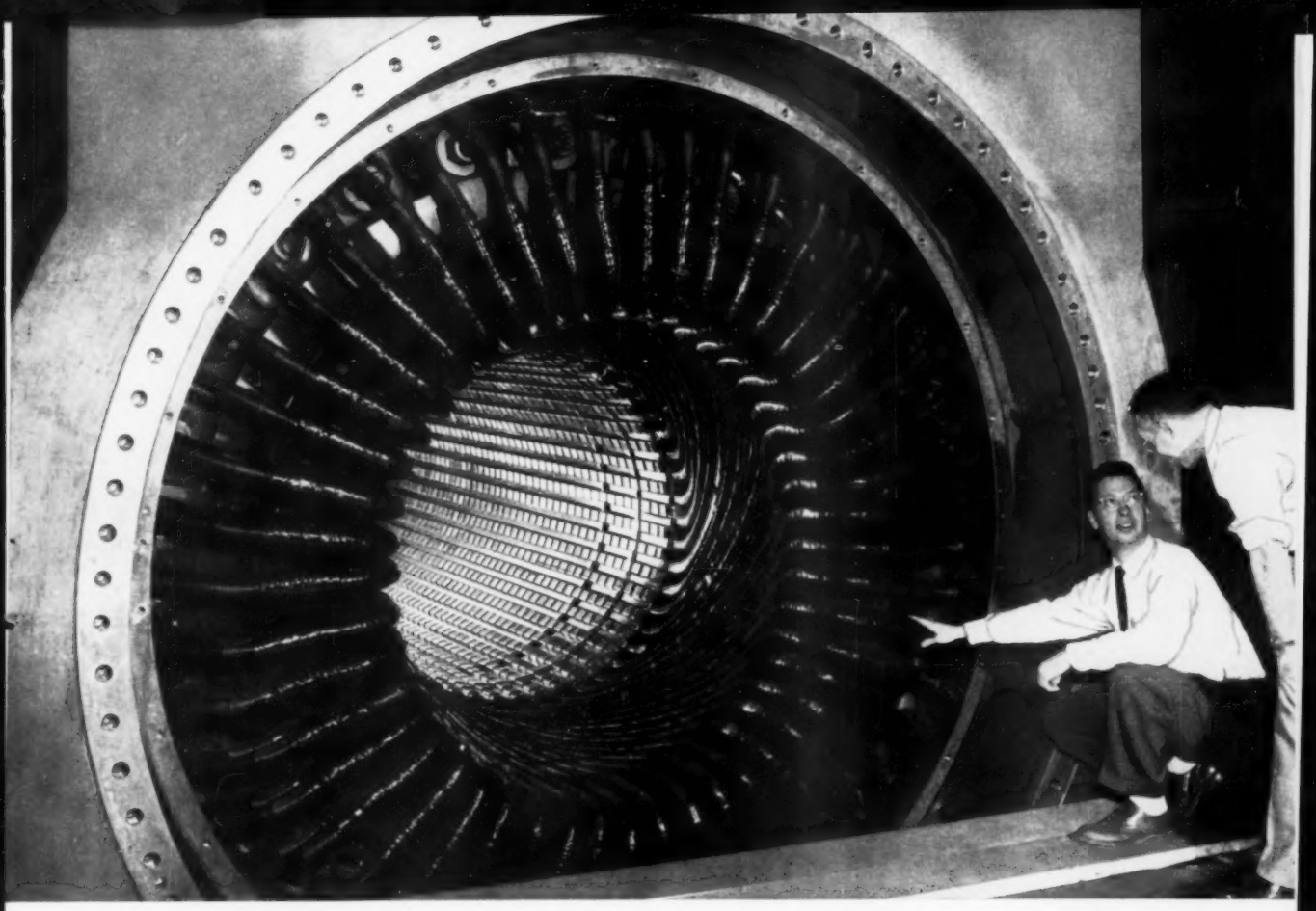
COMPLETELY INSULATED, the liquid connections between the stator bars and the liquid header leave no exposed copper. Note the design simplicity of this turbine end of the generator. The collector end also is extremely simple and has the appearance of conventionally-cooled units.

WITH HIGHER RATINGS NOW POSSIBLE FOR GENERAL ELECTRIC GENERATORS . . .

Liquid cooling system maintains



THE LIQUID CONNECTIONS between the stator bars and the liquid manifolds provide complete electrical insulation. This simple arrangement at the turbine end of the generator is mechanically flexible and provides the long, reliable life required for turbine-generator operation.



dielectric simplicity and reliability

COMPLETE LINE-TO-NEUTRAL INSULATION ELIMINATES EXPOSED COPPER SURFACES

Despite the tremendous increase in unit output now available with direct liquid cooling of generator stators, the dielectric system remains basically as simple as for conventionally-cooled machines.

Complete insulation of the winding is provided, as in conventional cooling arrangements. Thus, with no exposed copper surfaces, possibility of electrical creepage flashover to ground is practically eliminated.

Within the stator bar, only insulation between strands is required since there are no central cooling ducts to insulate. Not only does this provide more effective utilization of stator slot space and better heat transfer, but it makes possible the simplest dielectric construction of the stator bar.

Dielectric simplicity is just one of the many important features of General Electric liquid-conductor-cooled generators. Other outstanding advantages are:

Increased Generator Output—*Hollow strand stator bar construction can remove up to 16 times more heat than conventional cooling arrangements, permitting higher generator ratings.*

Improved Performance—*Liquid cooling permits automatic regulation of stator winding temperature independent of load.*

Dependable Operation—*Many unique features are incorporated into the design of the closed coolant system to provide a permanently tight liquid circuit.*

Shorter Maintenance Inspections—*Simple, single-stage, low-pressure hydrogen circulating fans facilitate disassembly and inspection.*

For more information on liquid cooling, contact your nearest Apparatus Sales Office or write to Section 254-75 for bulletin GER-1231, Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

For more data circle 516 on Post Card

...another

The *Exclusive* Single

Saves Space

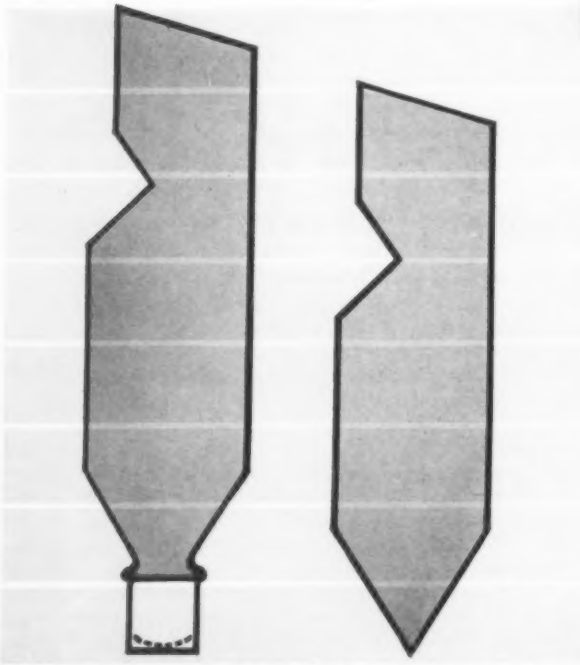
Reduces overall height of structure. Permits higher capacity in restricted area.

Adaptable to

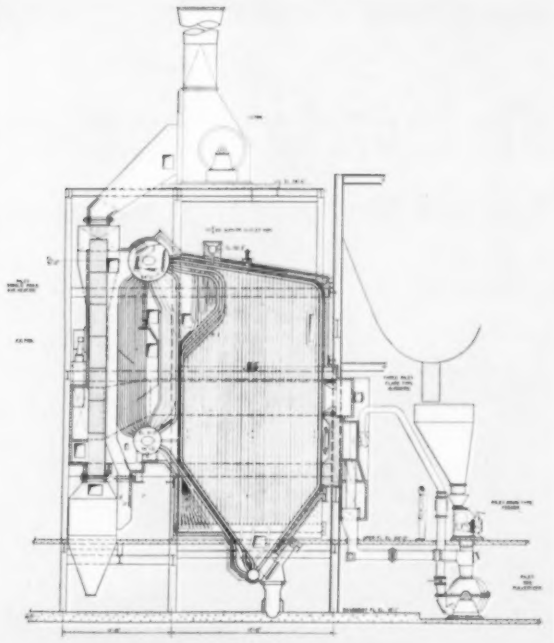
High capacity central station type units

and to

Small industrial type units



Unit with hopper added. Single Header Hopper Unit.

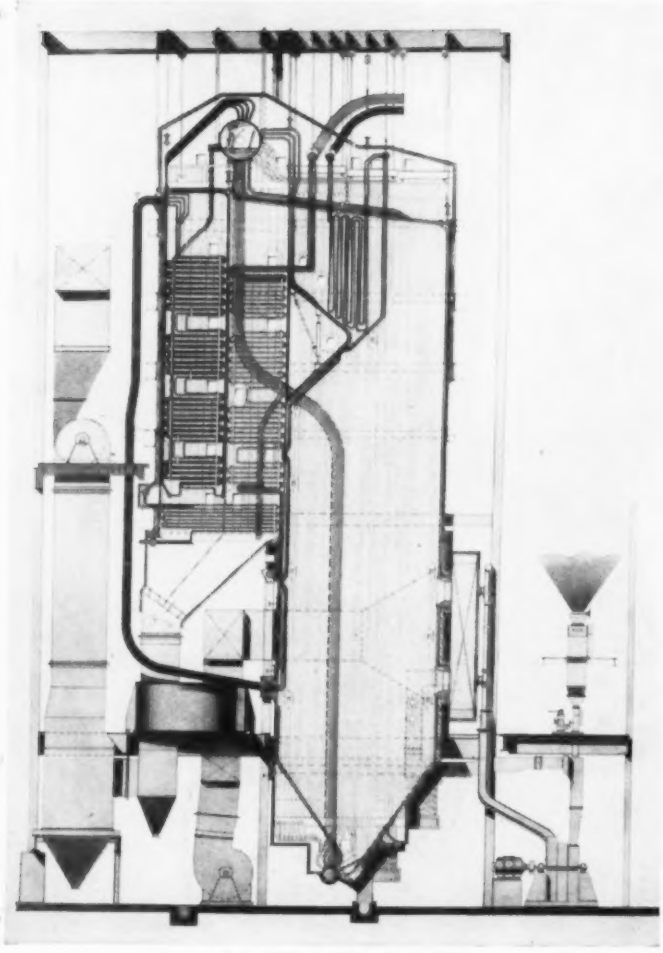


A 60,000 lbs/hr industrial type unit with Single Header Hopper

A survey of your plant by qualified consulting engineers could show ways of making surprising savings in your power costs.

money saving RILEY design feature

Header Hopper Bottom



A large Riley public utility reheat unit with Single Header Hopper

The Riley Single Header Hopper is so called because the furnace wall tubes are used as the sloping sides of the hopper and connect to a single header at the bottom. This simple arrangement eliminates the space required to install a separate ash hopper, thus reducing the overall height of the unit and permitting a unit of higher capacity to be installed where head room is a limiting factor. Additional savings are realized in the elimination of hopper seals and their maintenance.

Riley units with Single Header Hopper Bottoms are especially suited to multiple fuel firing and are extremely successful with coals of low ash fusion temperature. If installed initially to burn either coal or gas, coal can be burned at any time; a simple hydraulic or pneumatic ash removal system can then be added.

Riley Single Header Hopper Bottom Units are furnished in any steam capacity, temperature and pressure.

It will pay you to investigate further the economies possible in this exclusive Riley design feature.

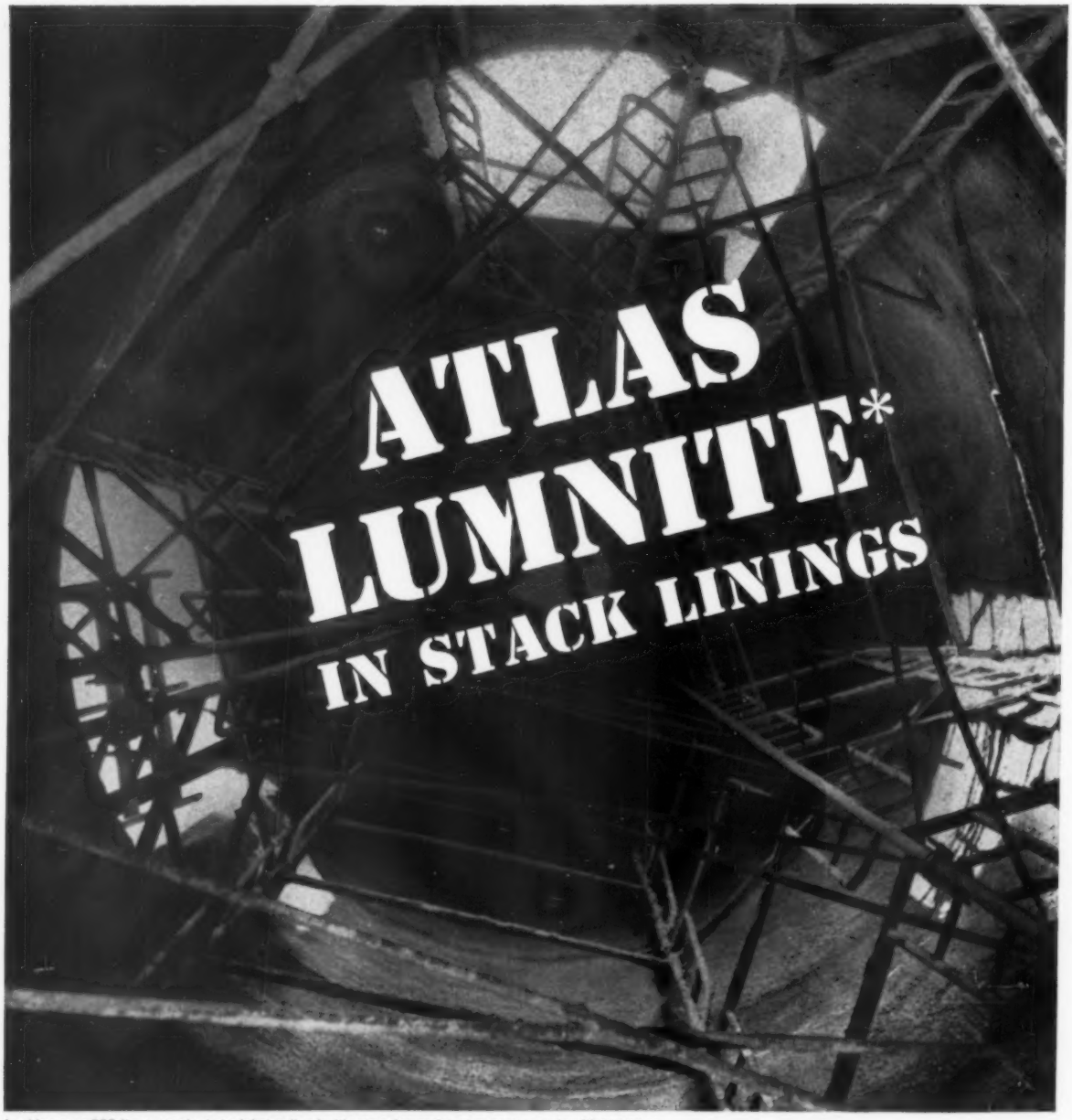
RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT

Riley Stoker Corporation, Worcester, Mass.

Atlanta, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, St. Louis, St. Paul, Salt Lake City, San Francisco, Seattle, Worcester.

For more data circle 518 on Post Card



Looking up a 200-ft. power-plant stack being lined with corrosion-resistant concrete made with LUMNITE cement. One of two stacks (Units 4 and 5) of Pacific Gas & Electric Company's Contra Costa Power Plant near Antioch, Calif. Gunite Contractor: Johnson Western Gunite Co., Gardena, Calif.

- Industrial concretes, made with LUMNITE calcium-aluminate cement and suitable aggregates, resist heat, corrosion, abrasion, thermal shock – and provide insulation.
- Placement is fast and easy – by guniting, pouring or plastering.
- Downtime is reduced to a minimum because concretes made with LUMNITE cement are ready for service in 24 hours.

For maximum convenience, use castables made with LUMNITE cement. These are packaged mixtures, ready for use. Just add water, mix and place. Made and distributed by leading manufacturers of refractories.

Write for a copy of the "Lumnite Mortar Manual," describing gun-applied linings: Universal Atlas, 100 Park Avenue, New York 17, N.Y.

"LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company

L-168

UNIVERSAL ATLAS CEMENTS

USS TRADE-MARK

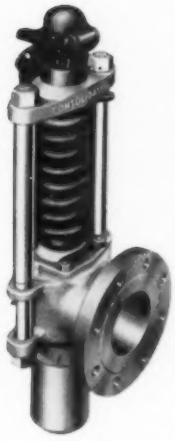
UNIVERSAL ATLAS CEMENT COMPANY – member of the industrial family that serves the nation – **UNITED STATES STEEL**

OFFICES: *Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St. Louis · Waco*

For more data circle 519 on Post Card

STOPS VALVE LEAKAGE

at high pressures



Consolidated "Maxiflow" Safety Valve, Type 1700 Series, Sizes: 1½" thru 6".

The Thermodisc Seat in Consolidated "Maxiflow" Safety Valves solves the problem of valve leakage at high pressures, saves steam and reduces maintenance.

Research has shown that when a safety valve on high pressure service reseats after popping, a small amount of leakage occurs momentarily between seat and disc before the valve seals off and becomes tight. This leakage is comparable to steam flow through small, individual orifices.

When a small steam leak exists at some point on the valve seat, the area near the point is cooled by the refrigeration effect of the escaping vapor. The metal tends to contract causing slight deformation of the seat. This acts to increase the gap size between disc and seat bushing at the leakage point. The size of the gap increases rapidly until the rate of leakage becomes extremely high.

The Thermodisc Seat prevents seat distortion and consequent leakage with a seat element recessed to form a thin wall at the area of seat contact. This design permits a high rate of heat-transfer in the metal *that eliminates all thermal differences.*

The result is a degree of tightness, essential to the operation of safety valves in high pressure services, never previously achieved. For complete details, write for Bulletin 707B.

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

C1-58

CONSOLIDATED SAFETY VALVES

A product of

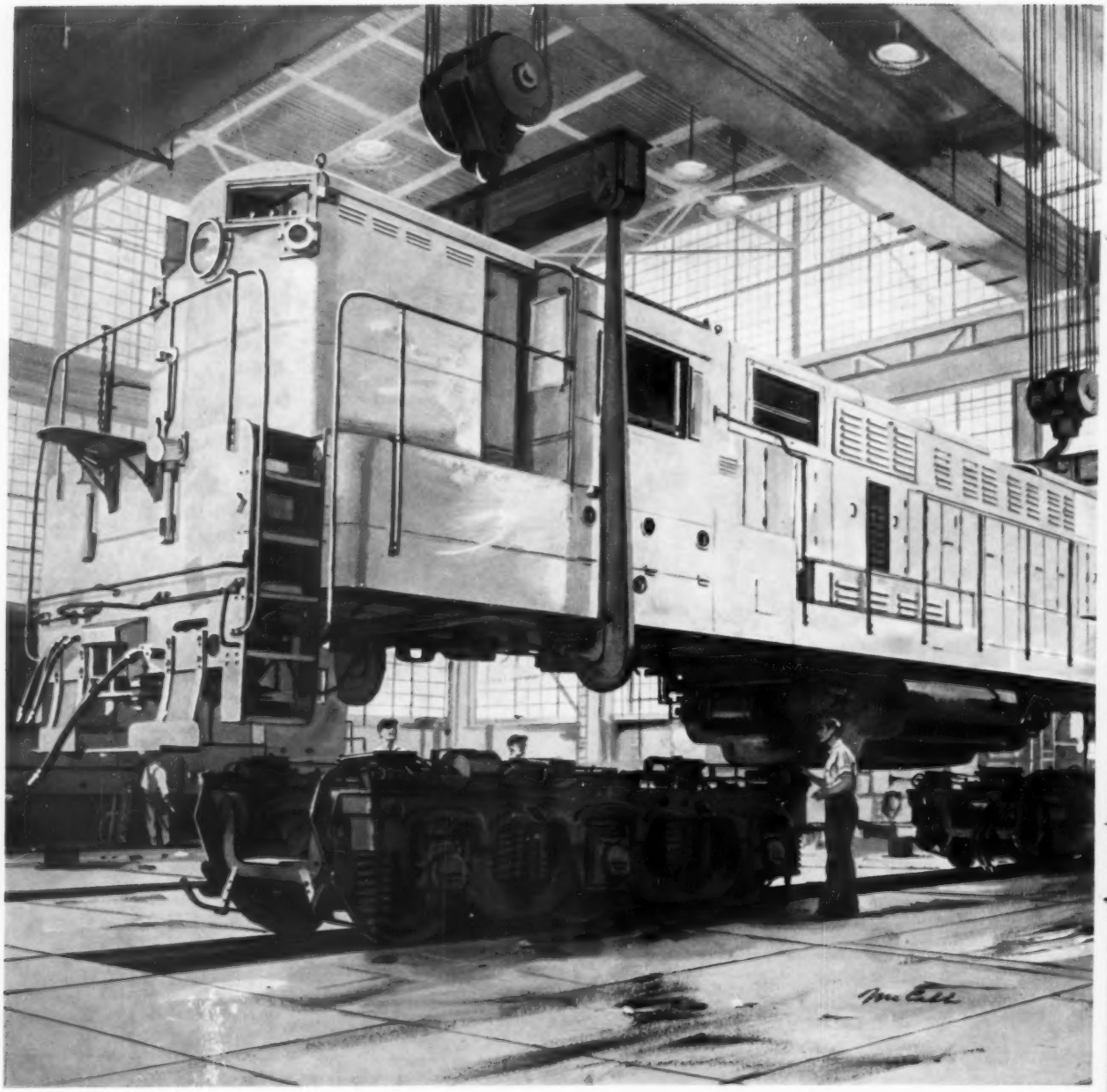
MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more data circle 520 on Post Card

Correct Lubrication in Action . . . in the

Maintenance cost cut



Mobil

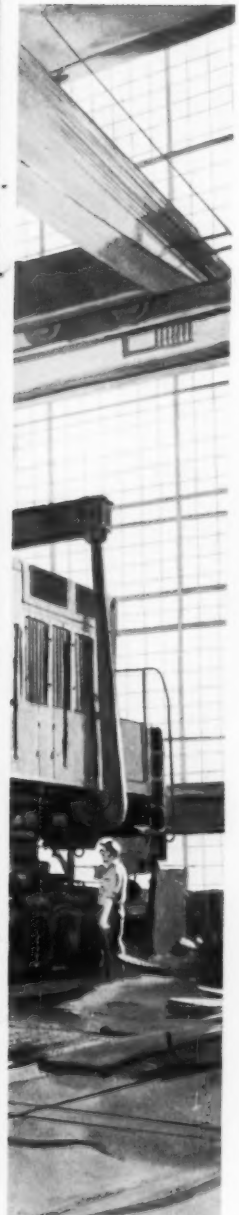
Complete Engineering Program
Proved Petroleum Products

Mobil

SOCONY MOBIL OIL CO., INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

Heavy Equipment Industry!

$58,500 in one year!



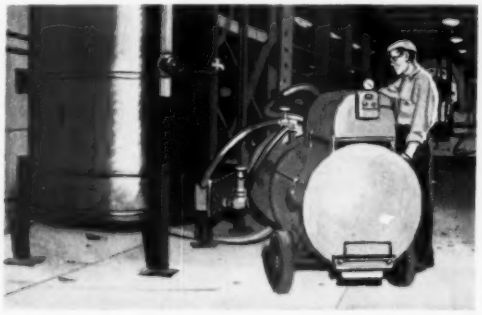
One of the many maintenance and production savings achieved by Fairbanks, Morse & Company with the help of Socony Mobil

In 1949, Fairbanks, Morse & Co. installed a Mobil Program of Correct Lubrication. This decision has continually paid off, as it can for you, by directly contributing to company profits.

To illustrate: First year after installation of a Mobil Program in the company's Beloit, Wisconsin plant figures showed machine repair maintenance costs were reduced 26.3 percent . . . $58,500. In fact, plant supervisors and Mobil engineers have co-operated so effectively under this service that today . . . nine years later . . . the Program shows continuing benefits, with the result that machine repair maintenance costs are now 49 percent lower than when the Program was inaugurated.

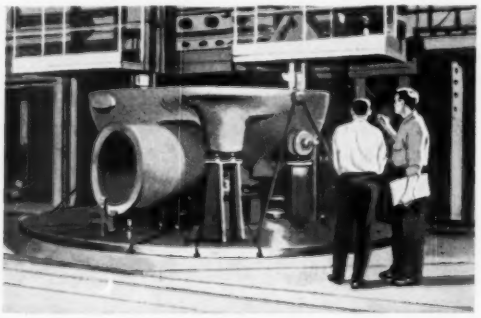
In dollars, this saving yearly is in excess of *twice the cost of plant lubricating oil requirements.* Here is another example of how Correct Lubrication in action can reduce maintenance costs and *increase profits.* It proved effective for this leading builder of heavy equipment. Why not for you?

In-plant training conducted by Mobil specialists demonstrates proper lubricant application and maintenance procedures . . . teaches Fairbanks, Morse personnel to recognize and prevent trouble before it results in downtime, repair costs.



Disposal of thousands of gallons of water-soluble cutting oils posed serious, expensive problem. Mobil recommendation of chemical separation process allowed disposal through plant sewage system . . . avoided stream pollution, saved substantial sum.

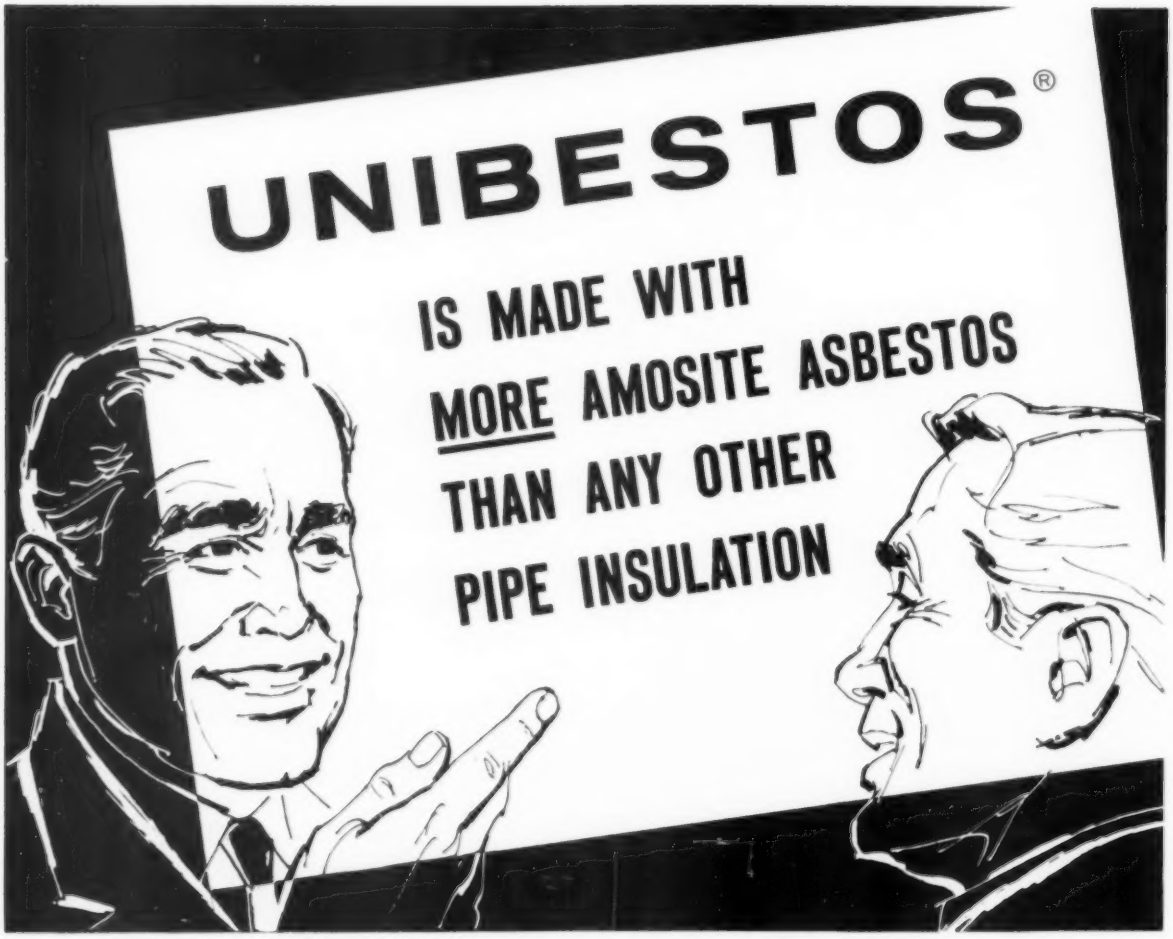
Control system cuts downtime:—Mobil lubrication charts cover plant's 2,300 machines . . . specify correct lubricants, lubrication periods . . . assure follow-through on application and maintenance.



High temperatures of Boring Mill way lubricant lowered viscosity . . . resulted in pressure drop, causing machine to stop. Mobil recommendation solved problem, allowed continuous operation.

Correct Lubrication

Another reason You're Miles Ahead with Mobil!



It's a *sure* way to save maintenance money!

Most insulations use merely a scattering of asbestos fibers to hold the mass together. So it's easy to see why UNIBESTOS is far stronger and so much *tougher*. Hammer blows can dent the surface, but never shatter or crack it. You can cut UNIBESTOS cleanly without breakage—walk on it. And, best of all, UNIBESTOS stands up like nothing else can with continued high thermal efficiency.

At competitive prices, rugged UNIBESTOS brings you the added advantages of easy installation, single-layer application, simplified fabrication for curves and fittings, unlimited re-usability, unmatched resistance to water and weather.* It's the favorite wherever used—the *standard* in modern power plants from coast to coast. We'll be glad to send you complete information on durable UNIBESTOS...the only pipe insulation made almost entirely of Amosite asbestos. Sizes to 44" o.d.

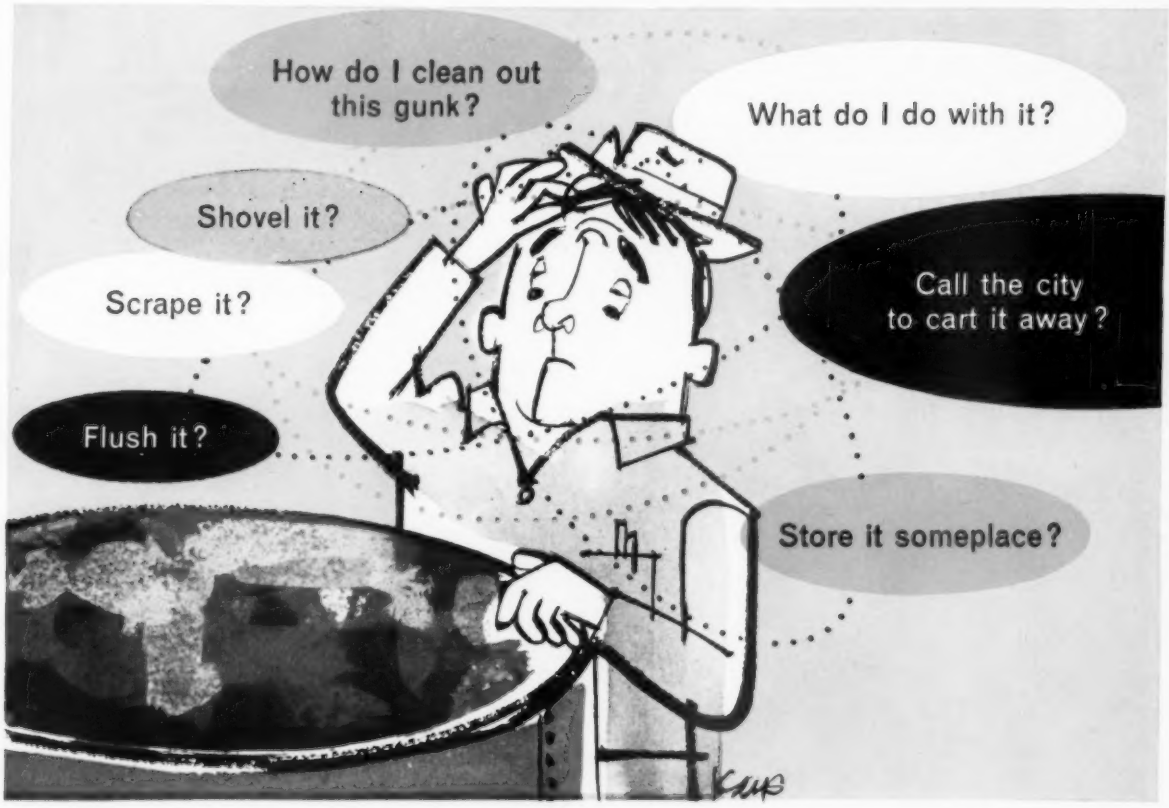
*An exposed and non-weatherproofed installation of single-layer UNIBESTOS, applied to 1500° pipe although its temperature limit normally is considered as 1200°, already has been removed for pipe inspection four times and re-installed as fully serviceable.

UNARCO®

UNION ASBESTOS & RUBBER COMPANY
1111 W. Perry Street, Bloomington, Illinois

INSULATIONS • PACKING • GASKETING • ASBESTOS TEXTILES • INSULATING CEMENTS

For more data circle 522 on Post Card



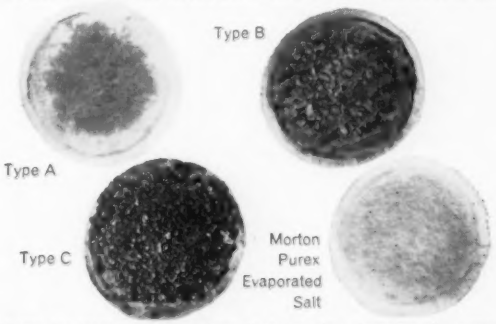
Brine tanks never need cleaning out when you use sludge-free Purex Salt

Yes, we mean never! You prevent costly shutdowns for maintenance. You save time and completely eliminate labor costs for cleaning out brine tanks. For Morton Purex Salt is 100% soluble. It will leave no accumulation of sludge—shale and sulphates—in either your brine or water-softening system.

What's more, none of your purchase price or freight bill for Purex goes toward paying for insolubles. This is an important saving, for in every 100 lbs. of ordinary salt you buy, you assume the risk of paying for up to 5 lbs. of shale and sulphates. In a 50-ton carload of ordinary salt, you may pay for as much as 5,000 lbs. of sludge. And you buy salt with "built-in" maintenance problems.

With sludge-free Morton Purex Salt, you get high-purity evaporated salt made in a controlled-particle size to prevent packing and channeling. Purex can be used in bulk wet storage systems and in the Morton Model E Brinemaker.

These filter pads (approximately 1/6 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various types of salt



Tests for insolubles taken from these random samples show you that Morton Purex is the only one that contains no wasteful sludge or insolubles.

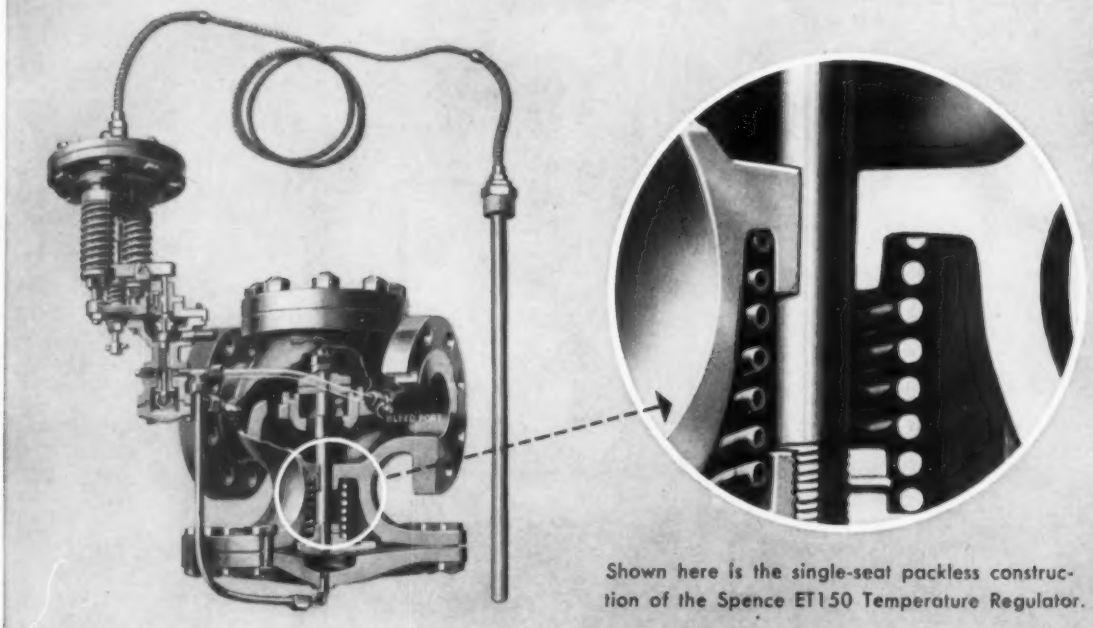
For more information about Morton Purex Salt and for free, expert help on any water-softening or brine-making problem, write or wire:

MORTON SALT COMPANY
INDUSTRIAL DIVISION
Dept. PoE 4-58, 120 So. La Salle Street,
Chicago 3, Illinois

For more data circle 523 on Post Card

VALVE TIPS:

Advantages of Packless Construction in Temperature Regulating Valves



Shown here is the single-seat packless construction of the Spence ET150 Temperature Regulator.

One of the biggest headaches in regulating valve maintenance is repacking stuffing boxes.

How often a valve needs repacking, how much time it takes, and the cost of the system downtime all vary with the construction of the regulator and the service it's used for. No matter how you calculate all these variables it's still a headache—and an expensive one.

In the temperature regulator shown above (Spence Type ET150) stuffing boxes are eliminated. This is done by what is known as "balanced" diaphragm construction. You can see in the cutaway drawing that pressure is applied to both sides of the large metal diaphragm. The upper side is exposed to delivery steam pressure and the lower side is exposed to loading pressure applied by the pilot. When the pilot closes, both delivery pressure and loading pressure are equalized through the bleedport and connecting tubing.

This construction not only does away with repacking problems, but it makes possible additional savings as well. For example, you will note in the sectional blow-up that this design eliminates a closely fitted stem and guide. Dirt or other foreign matter doesn't have much of a chance to lodge between these parts and cause sticking.

Another cause of binding or sticking, uneven expansion of closely fitted parts, is also eliminated with this design. In addition, valve stem wear is reduced for the same reason.

Lower maintenance is not the only advantage of this packless construction. Accuracy of regulation is also improved because friction due to a stuffing box, dirt, or uneven expansion is not a problem. The large, *balanced* metal diaphragm is more sensitive to slight changes in pressure.

Guaranteed Not To Wiredraw

If seats and discs are cut by steam (wiredrawn) the loss of steam through these grooves can be another expensive item — directly charged against the regulating valve. Fortunately, you can eliminate these costly leaks by specifying a temperature regulator that is *guaranteed not to wiredraw.*

Spence makes such a guarantee because their seats and discs are made of SECO Metal. Over 20 years experience with this special alloy has failed to produce a single case where a SECO Metal seat or disc had been cut by steam. All that's required is an approved strainer located ahead of the regulating valve. Expensive steam leaks just can't happen with this combination of SECO Metal and single-seat design.

If you would like to have more information on Spence Temperature Regulators, drop us a line and ask for Bulletin T150. It gives more detailed information on these and other Spence design features. Piping layouts and helpful information on the installation of temperature regulators are also included. Write for your copy today.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

BK 140

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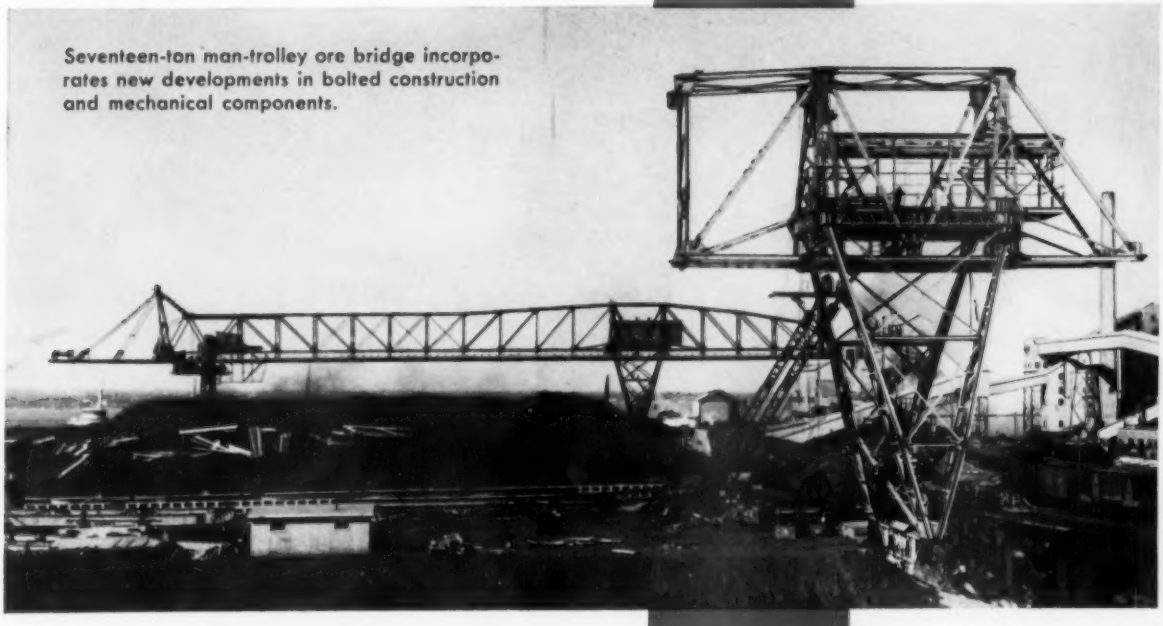
for Major Canadian Steel Producer



Seventeen-ton man-trolley ore bridge incorporates new developments in bolted construction and mechanical components.

This new 17-ton Mead-Morrison direct ship unloading and stocking ore bridge features, in addition to the advanced Mead-Morrison construction that has been proved in the preceding four bridges, a number of exclusive Mead-Morrison developments. These include the use of high tensile steel bolts at all field connections for strength and economy of structural maintenance, extra safe hydraulic rail clamps, new hydraulic buffers, and a new type of man-trolley suspension.

This bridge joins a seventeen-ton bridge completed in 1952, a twelve-ton bridge built in 1942, and two twelve-ton bridges installed in 1931. All these bridges were designed, engineered and built by Mead-Morrison and have given complete satisfaction throughout their life.

If you have material handling problems, you can find your answer by writing to Mead-Morrison.

Mead Morrison

Division of

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Manufacturing Engineers, Harrison, N. J.

Also builders of coal and ore bridges, coal and ore towers, bucketers, pile hammers, and specially designed machinery.

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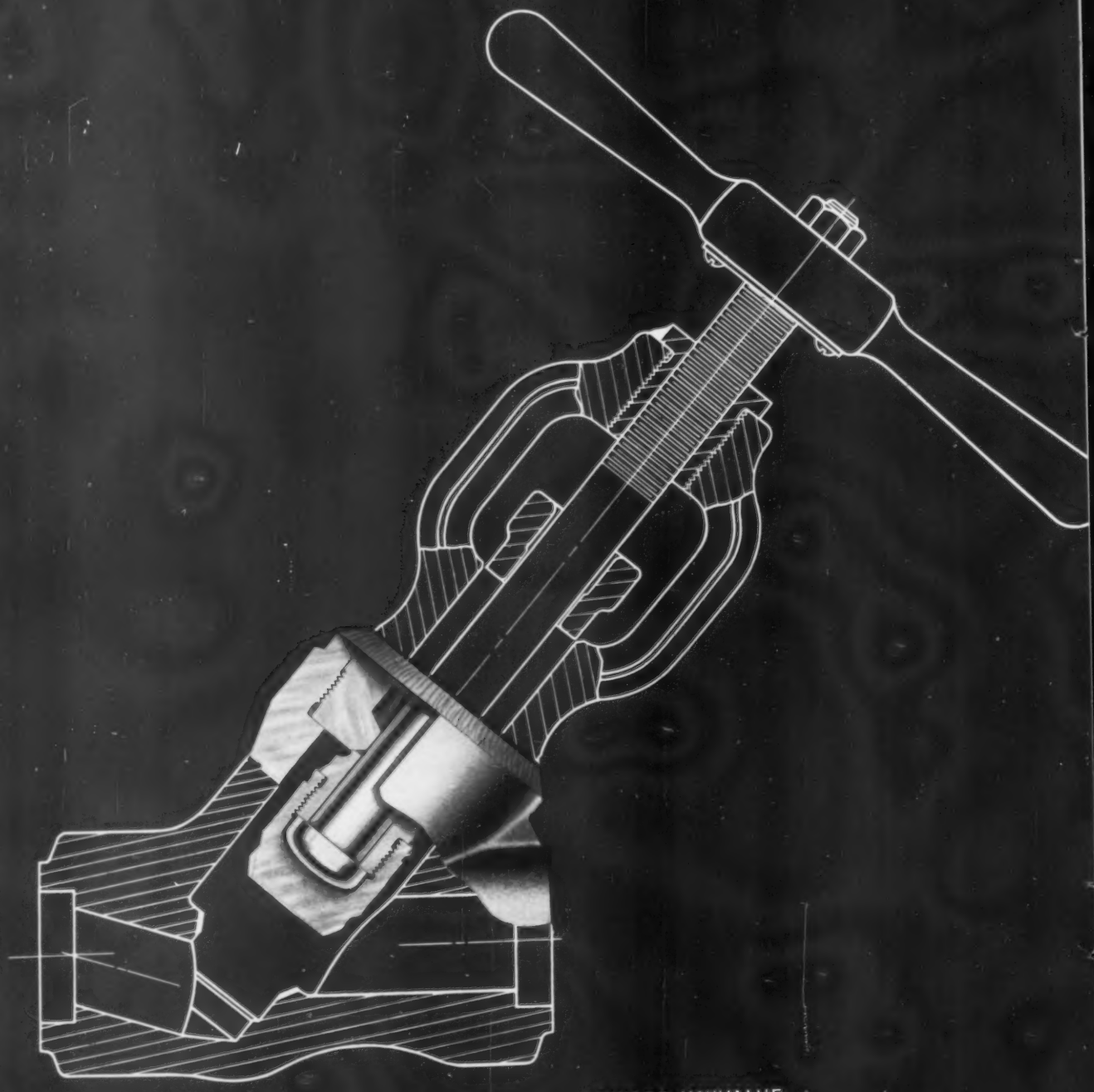


EDWARD UNIVALVE

What's New from Edward Valves, Inc.

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Shoulder, thread and weld make

Superior "Univalve" Body-Bonnet Joint

Edward valve researchers were assigned three main goals in developing the Univalve* . . . first, design a globe valve for high pressure-temperature service—that would *stay* leak-proof . . . second, eliminate—as far as possible—the necessity for maintenance . . . third, fabricate all pressure-containing parts of forged steel for maximum strength and soundness.

How well they succeeded is illustrated by this fact: in many hundreds of advanced temperature-pressure applications all over the world, Edward Univalves have given consistently superior service. The *reason* for this is simple . . .Univalves, properly maintained, simply do not leak.

WELD SEALS JOINT

In the Univalve, a bead of fine-grained weld seals the body-bonnet joint to maintain perfect pressure tightness in any service. A guiding section above the threads protects them from the seal-weld; the threaded section and body shoulder carry the pressure load and insure accurate alignment. The rugged threaded bonnet—with opening just large enough to accommodate the stem—provides a pressure-tight backseat. The radiused disk nut contacts the beveled bonnet backseating surface . . . isolates packing from line pressures and temperatures . . . stretches packing life.

While the Univalve rarely needs attention, even its tough integral Stellite seating surface *can* become scored under some conditions. To strip for inspection and possible re-lapping, the seal-weld is easily removed by machining or grinding or with carbon arc or oxy-acetylene scarfing tip. Besides simple disassembly and positive backseat advantages, Univalve's one-piece gland eliminates possible small parts loss during repacking.

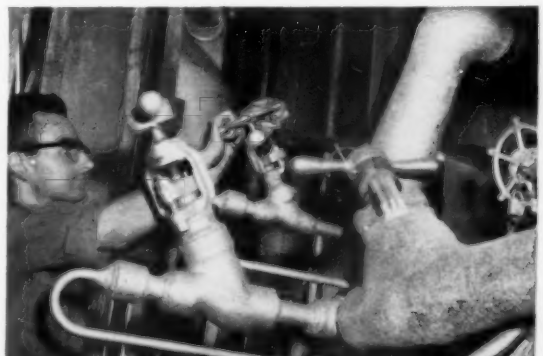
IMPORTANT UNIVALVE FEATURES:

Streamlined Flow Path reduces pressure drop, minimizes wear-producing turbulence. Univalve meets requirements for blow-off service.

Simple Packing Adjustment keeps packing maintenance down. Sturdy gland bolts, roomy yoke, one-piece forged gland.

Easy Open—Tight Close Operation of all Univalves 1¼" to 2½" made a reality with the exclusive Edward Impactor* handle.

Continuous Stellite Ring applied to body and disk, retains hardness under temperature and resists wear.



4500 LB UNIVALVE in service at Ohio Power Company's supercritical Philo station.

*T.M. Reg. U.S. Pat. Off.

IDEAL FOR BLOW-OFF SERVICE. Univalves meet ASME Code for blow-off service and are adaptable for all high pressure installations.

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Subsidiary of ROCKWELL MANUFACTURING COMPANY

1202 West 145th Street, East Chicago, Indiana

Edward builds a complete line of forged and cast steel valves from ⅛" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 7500 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

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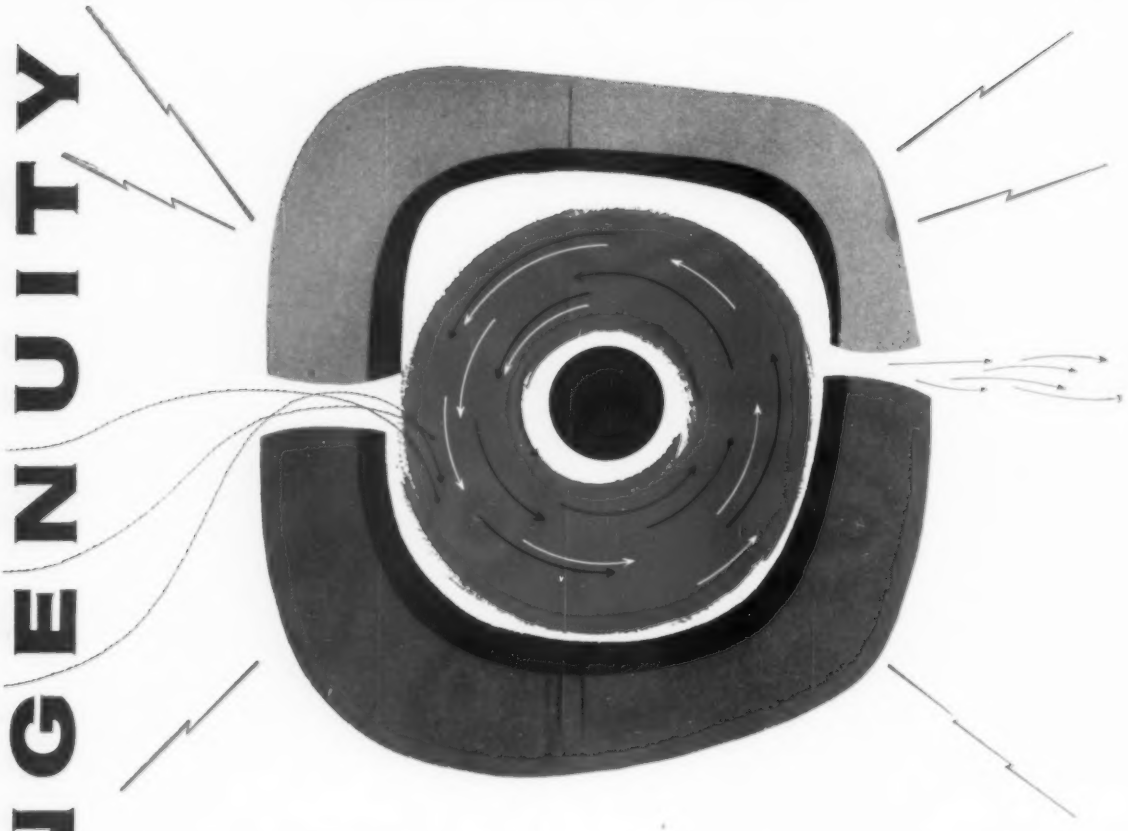

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ATOMICS

A section of POWER ENGINEERING covering current and forthcoming developments in the field of Nuclear Power throughout the world

ANDREW W. KRAMER
Editor

CONTENTS

Time To Stop Baiting Scientists 43
Controlled Thermonuclear Progress in the United States and Britain 44
Many years of intensive work will be required before a fusion reactor can be developed that will yield more power than it takes to run it, but results of research, so far, are sufficiently encouraging to justify continued effort and expense for further development
Nuclear Development in Eastern Europe
By Stephan E. Schattmann 47
While much information has been issued concerning nuclear power development in the Western European countries, very little has come to us about nuclear development in the countries in the Soviet Bloc. Here, in this article, a London observer tells what is going on in East Germany, Poland, and Czechoslovakia
How the APPR was Prepared for Start-Up
By J. M. Totten 50
Last June, in POWER ENGINEERING, we described APPR, the Army Package Reactor, in considerable detail. Now, in this article, a Stone & Webster engineer tells how this plant was prepared for start-up. The almost surgical cleanliness required will be found very interesting to engineers of conventionally fuel fired plants
New Nuclear Literature 52

TIME TO STOP BAITING SCIENTISTS

FEW PEOPLE not in possession of the facts have any idea of the damage done to American scientists by the political abuse of the personnel security system during the past decade. It is for this reason that I would like every sincere person in the United States to read the address given by E. U. Condon at the banquet of the American Physical Society in St. Louis, last November. Dr. Condon, you may recall, was forced to resign from his position as Director of the Bureau of Standards because of supposedly subversive activities, despite the fact that none of the accusations against him were ever proved. Dr. Condon's speech was presented in the February issue of the Bulletin of the Atomic Scientists. In it he recounts his experiences, and it makes a sad, painful story, indeed. "During the last two months," said Dr. Condon, "there has come about a general public awareness that America is not automatically and effortlessly and unquestionably the leader of the world in science and technology. This comes as no surprise to those of us who have watched and tried to warn against the steady deterioration in the teaching of science and mathematics in the schools for the past quarter of a century. It comes as no surprise to those who have known dozens of scientists who have been hounded out of jobs by silly disloyalty charges, and kept out of all professional employment by blacklisting. It comes as no surprise to those of us who have known how good American scientists have had to face vilification by political speechmakers in and out of Congress, have been falsely prosecuted for perjury, have been improperly denied passports or had their passports seized and invalidated without due process by the State Department, or those who have had their telephones tapped or letters intercepted by government agents. . . . For while we are rich and powerful, we have not been true to the principles of freedom for which we stand."

And so Dr. Condon tells first how he was hounded out of the Bureau of Standards because he had been interested in the American-Soviet Science Society, an organization which had received a grant from the Rockefeller Foundation ten years ago to foster translation and wider distribution in this country of Russian scientific literature. Now, as he puts it, a decade later we read of a crash program to translate Russian scientific literature and spread it around this country.

This is one man's story. Now Dr. Condon is Professor of Physics at Washington University in St. Louis. Of course, as he says, "some people have tried to stir up trouble here (too) but we are proud at Washington University of our successful record in defense of freedom. As you walk around our campus during these meetings, breathe deeply of the free air of the University and the City of St. Louis. Take some of it away with you, for we have enough and can afford to export it."

Andrew W. Kramer

Controlled Thermonuclear Progress

Years of intensive work will be required to develop a fusion reactor that will yield more power than it consumes, but results of research so far are sufficiently encouraging to justify the continued effort

THE RECENT release of technical reports on certain advanced areas of research in the field of controlled thermonuclear reactions by the United States Atomic Energy Commission and the United Kingdom Atomic Energy Authority brings into question the possible effect that success in this field might have on the current development of nuclear power from fission reactions. There are some who question the prudence of spending hundreds of millions of dollars on fission type nuclear power plants if there is a possibility that they may be rendered obsolete by the successful design of a thermonuclear power reactor.

The question, understandably, is logical but it arises only in the minds of those who are not close to development in the thermonuclear field and who are not aware of the difficulties and uncertainties that lie ahead. For these are many and it may take far more time to resolve them than the optimistic reports issued in January may have led many people to believe. This does not imply that the reports were untrue; on the contrary, they were extremely factual but their release was brought about under circumstances that tended to obscure the difficulties by the emphasis on the initial success of the experimental work on both sides of the Atlantic.

Scientific Olympics

As in the case of the international rivalry in the satelite programs, it is unfortunate that this research in the thermonuclear field should have developed into a sort of scientific Olympics race between the United States and England with each side claiming lead over the other. All this could easily have been avoided if, from the beginning, thermonuclear research had been carried out in the open, not under the senseless curtain of secrecy. The development of a controlled thermonuclear reaction is essentially a peace-time project; it has no relation to military matters except insofar as a fusion reactor might serve as a means of propulsion in naval vessels or other military mobile equipment. It is within the realm of possibility that the hydromagnetic techniques being developed to contain the extremely hot gases in thermonuclear reactions might also be used to develop a very efficient propulsion system for future space ships.

It is curious that despite the attempts to keep fusion research under the wraps of secrecy, the nature of the experimental work which has been going on during the last four years has been generally known to most scientists throughout the world. In 1954 reports were issued concerning the experiments on the pinch effect at Tufts University and Dr. Lyman Spitzer's early work at Princeton University along the same general lines was disclosed about the same time. Even Los Alamos' Perhapsatron was described in a rough way some two years ago. So, the general character of the research was known. Knowledge of the pinch effect goes back almost to Clerk Maxwell and its practical effect was made manifest in the work of the early experimenters with electric furnaces using a ring of molten metal as the secondary of a transformer. A paper presented before the American Institute of Electrical Engineers by Dr. Carl Herring[1] in February, 1923, describes the pinch effect very clearly. So its application to the constriction and containment of a ring of ionized gas in thermonuclear research must have occurred to a number of investigators independently. It is significant that Kurchatov's address at Harwell in March 1956 indicated that the Russians were using the pinch effect and were proceeding along essentially the same lines as the Americans and the British. In view of all this and the sudden release of the technical information in January one wonders what, if anything, lay behind the futile attempts to keep thermonuclear research classified for the last four or five years. Surely nothing was gained by it, and in the scientific Olympic race that finally ensued, we scored somewhat less than the British, who apparently were not in sympathy with our efforts to keep the work secret.

Temperature Was the Secret

About the only thing that was not known before the release of the technical papers in January was the temperature that had been attained in the various laboratories. Kurchatov indicated that the Russian work involved temperatures of the order of one million degrees. This in itself was a remarkable disclosure, indeed, it was this Russian paper in March 1956 that for the first time discussed thermonuclear research in detail and as some competent scientists in the United States commented at the time, it was unfortunate that the release of this information should have come from behind the so-called Iron Curtain. It was only after the Kurchatov speech that a limited amount of information on thermonuclear work in AEC laboratories was released.

The basic principles of fusion reactions have been known for many years, indeed, for the last quarter of a century scientists have been effecting such reactions by bombarding targets with protons and deuterons. Deuterons are nuclei of heavy hydrogen. Such bombardment was carried on by means of high energy accelerators and while the experiments were successful as far as the reactions were concerned, they were hopelessly inefficient. Vastly more energy was required to effect the fusion than was released. The lack of success with this kind of experiment made it clear that the most effective way of establishing a sustained fusion reaction would be by raising the temperature of an entire mass of hydrogen, particularly heavy hydrogen, to a value such that the kinetic energy of the nuclei would

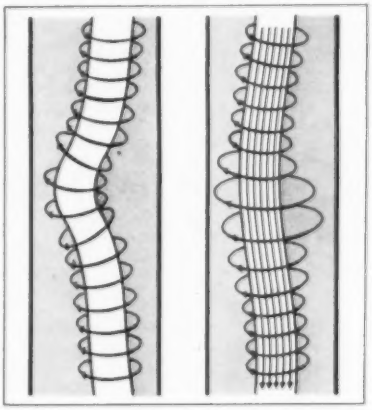


Fig. 1. Diagrams showing how the instability of the pinched discharge at the left can be stabilized by means of a longitudinal magnetic field within the plasma, as shown at the right

ATOMICS

[1] Electromagnetic Forces; a search for more rational Fundamentals; A Proposed Revision of the Laws.

In the United States and Britain

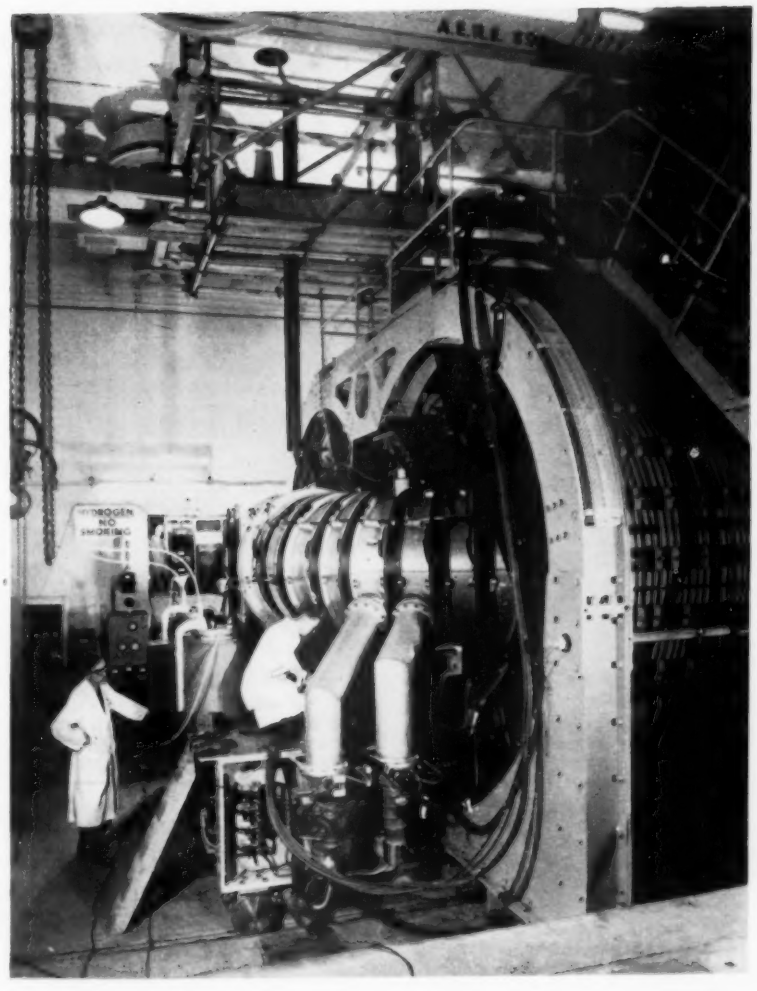


Fig. 2. This is ZETA, Britain's high power device used in their thermonuclear research. A partial view of the torus is shown here with the vacuum pumping system in the foreground. Coils wound on the torus produce the stabilizing field

bring about the desired fusion. This would be a thermonuclear reaction. A number of different types of reactions are possible, using different elements but the one that appears most attractive from a practical and economic standpoint is the one illustrated in Fig. 4. The upper diagram shows how two nuclei of deuterium (heavy hydrogen) merge to form a nucleus of tritium (the second isotope of hydrogen, i.e., a nucleus consisting of one proton and two neutrons) and a proton. These separate at great speed. In a given mass of deuterium, about half of the collisions result in this rearrangement. In the other half, the products are a neutron and a nucleus of Helium-3, as shown in the lower diagram. In both cases there is a great release of energy. The neutrons escape freely through the walls of the tube and can be studied outside with a variety of detection instruments.

The big problem is in raising the mass of ionized gas to a high enough temperature to cause the deuterons to collide violently and repeatedly. Even in a very hot gas (plasma) a collision between two ions resulting in fusion is rare. The vast majority of collisions simply result in an exchange of energy between the two ions, similar to the collision of two billiard balls. If a *hot* ion is to stay hot until it makes a fusion collision, it must only collide with other hot particles and not with cool ones. Thus the problem is to make the gas uniformly hot.

This is where the pinch effect comes in. It is well known that an electric current is surrounded by a magnetic field regardless of the nature of the conductor. If the current is very strong the magnetic field, which is at right angles to the direction of the current, tends to exert a constricting force on the conductor, and if the conductor is an ionized gas, it will tend to compress the gas into a thin, dense column. This is the principle involved in all this research. The goal is to improve this situation. In the hot gas of a pinch tube all the deuterons are moving. If one deuteron is slowed down, it transfers part of its energy to another, which in turn may pass the energy to still another, and so on.

Instability of the Pinch

Quite early in the thermonuclear research program it was found that the pinched discharge is unstable. Asking the pinched current to stay quietly in the middle of the tube is something like asking a boa constrictor not to wriggle. Any slight kink in the pinched discharge would tend to grow rapidly and thus cause the discharge to touch the walls of the tube, thus cooling it. This tendency proved very troublesome. Still, ways to prevent this type of instability were found both here and in England. The pinch can be stabilized by two measures.

The first is to apply a magnetic field along the length of the tube before the voltage is applied. As the gas pinches down, it carries this magnetic field with it. The presence of the field inside the hot gas provides it with a kind of a back bone. But the field must be carefully chosen if good results are to be obtained. The second method is to enclose the discharge within highly conducting walls. The action of the wall is as follows: When the pinched discharge wanders slightly from the central position, it induces eddy currents in the wall. By the well-known classical laws, these currents are in such a direction that their magnetic forces push the discharge back toward the center.

As explained in the technical information released in January, both the British and the American scientists have succeeded in stabilizing the pinch to at least a limited extent. The British seem to have been somewhat more successful than the Americans because they reported that currents of 200,000 amperes had been passed through the ionized gas for periods of 5 milliseconds. With these discharges they attained temperatures as high as 5 million degrees. In the experiments thus far the United States has achieved temperatures as high as 6 million degrees, but only for a few millionths of a second. The British

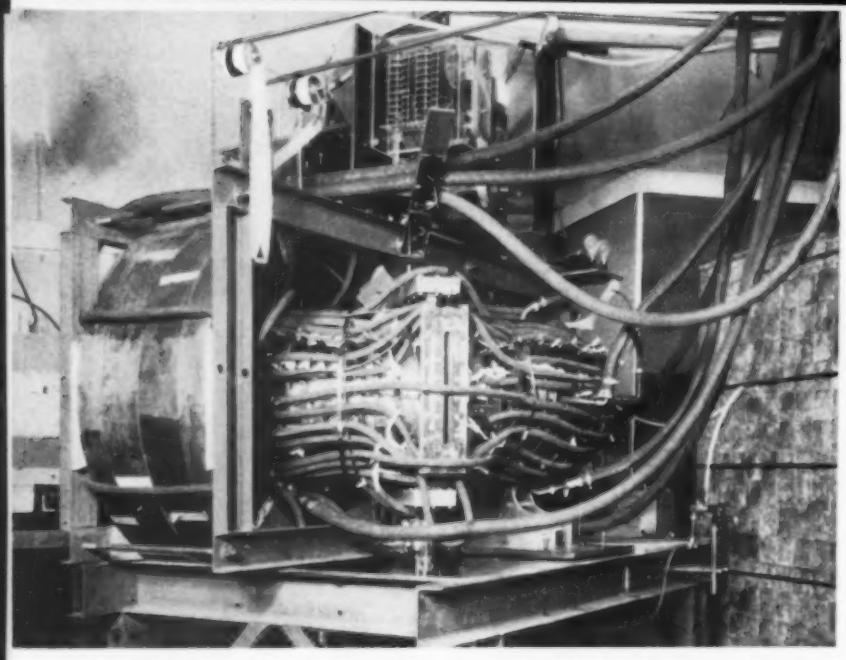


Fig. 3. And here is Sceptre Three, the thermonuclear device of Associated Electrical Industries costing only $28,000 with which temperatures of 4 million degrees were attained and temperatures of 10 and 12 million degrees are hoped for

reached this milestone last August with their doughnut shaped tube called ZETA. The United States achieved it in December with a small circular tube, inelegently known as the Perhapsatron, at the Los Alamos Laboratory.

These experiments were carried on under the government research projects in both Britain and the United States. At the same time that these results were released by the respective governments last January, a British team of industrial scientists reported that they had achieved in a small $28,000 glass-walled tube demonstrations of controlled fusion nearly as impressive as the results claimed by the British and United States agencies. Furthermore, the British industrial group reported that their expectations of achievements in the next year were considerably above anything voiced in the official analysis from either side of the Atlantic.

The British group is Associated Electrical Industries, Ltd. It reported that it had achieved neutron production from a hot plasma pinched to 4 million degrees for a few millionths of a second. Dr. A. A. Ware, the 33-year old scientist who heads this project, said that temperatures of 10 and 12 million degrees are "hoped for" in a few months. No such optimistic predictions have been made by any of the government agencies. In a larger model now being designed, Dr. Ware said, it is hoped that temperatures of from 30 to 40 million degrees will be reached by the end of this year.

Present Status of Work

At the present time the United Kingdom Atomic Energy Authority's ZETA at Harwell is the largest thermonuclear device in operation. In ZETA, the discharge chamber is a ring-shaped tube or torus of 1 meter bore and 3 meters in diameter, containing deuterium gas at low pressure. The tube is linked (i.e., encircled over a part of its length) by the core of a large pulse transformer. A pulse of electricity is sent through the primary winding of this transformer from a bank of capacitors capable of storing 500,000 joules of energy. This pulse induces a very large unidirectional pulse of current in the gas which forms a short-circuited secondary for the transformer. Peak currents up to 200,000 ampers have been passed through the gas for periods up to 5 milliseconds. Emission of neutrons throughout the current pulse is observed regularly in routine operation.

The American experiments have been carried on with smaller apparatus but the principles involved are essentially the same. Indeed, the Russians also are working along similar lines as was shown by Kurchatov's paper at Harwell. Kurchatov reported the attainment of temperatures around one million degrees and also the production of neutrons.

It is not certain in any of the experiments conducted so far, either by the English or the Americans, or by the Russians, that the neutrons produced in these reactions are true thermonuclear neutrons. Neutrons can be produced in such intense gaseous discharges in various other ways, and the next step in all these researches will be to prove beyond any scientific doubt that the neutrons come from thermonuclear fusion and not from other byproduct reactions inside the fusion chamber. There seems to be evidence that the neutrons are thermonuclear in origin but it still remains to be proved.

The third stage in the research will be to raise the temperatures. The British scientists believe that a temperature of around 25 million degrees can be obtained with the present ZETA apparatus. Robert Carruthers, the designer of ZETA thinks he can double this figure. A fourth stage in the program will be to build a machine capable of creating sustained temperatures in excess of 100 million degrees in a gas consisting of deuterium or temperatures of 40 million degrees in a mixture of deuterium and tritium. At this break-even point it is thought that power production would equal the power necessary to drive the machine. At the moment the energy output of ZETA is about a million-millionth of the energy input.

The fifth stage envisaged is an even more efficient hot gas machine, the prototype of a practical and economic thermonuclear power station.

In the United States research in this field is being carried out under Project Sherwood. This has been expanded some 30 fold in the last five years. It has grown from a total outlay in 1953 of $800,000 to a value of

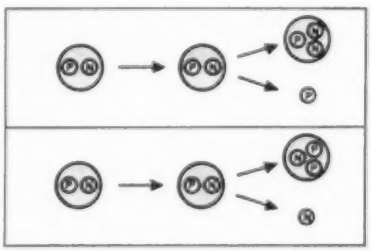


Fig. 4. Diagram showing the two possible fusion reactions in deuterium

$23 million to be spent this year. Most of the research is being carried out in five laboratories: Los Alamos Scientific Laboratory, the University of California's Radiation Laboratory at Livermore, Calif., Princeton University's Forrestal Research Center, the Oak Ridge National Laboratory, and New York University's Institute of Mathematical Science. The largest item in the current program is the construction of the Model C Stellerator at Princeton. This will be a very large apparatus — larger than the present ZETA, but, of course, the British also are planning a larger device.

This is the place to explain that when the pinch is not stabilized, there are at least two ways in which neutrons can be produced, without orig-

ATOMICS

inating from repeated thermal collisions in the gas. First, deuterons which hit the walls can react with others which are adsorbed on the walls, or buried in the wall material. Second, if the plasma (the ionized gas) breaks up into a number of irregular current channels, large voltages may arise between the various channels, and in other ways. Deuterons can be accelerated by these internal voltages and when they strike their neighbors, can react just as though they had been speeded up in an ordinary accelerator. Both of these methods of producing neutrons are considered undesirable because the number of effective collisions with the neighbors is relatively small. There is also a complicating circumstance. It is well known that the probability of effective nuclear collision increases very rapidly as the energy of the bombarding particle rises. If, for example, in deuterium, the temperature is raised from 5 to 10 million degrees, the power output from the nuclear collisions increases by a great factor, about 16 fold. Under present conditions, the fastest particles are the most effective neutron producers. This means that the two unwanted processes described may give enough neutrons to mask the ones coming from the real thermonuclear reactions.

With regard to temperature, it is not quite correct to use the word temperature in describing the condition of man-made thermonuclear plasma. Originally the term temperature was used as a measure of the energy of the molecules in cases where a body is quietly confined in a vessel, so that the various parts are all similar in their properties. But in a pinched discharge there are necessarily currents, and the discharge gives out x-rays in great quantity. Under such conditions one can calculate a number of different values for what we may call an effective temperature or nominal temperature. For example, from the neutron output we get a value which might be called "the temperature judged by the neutrons." It is simply the value which the temperature would have to be in a quiet plasma to give the number of neutrons observed. Similarly, there can be a temperature calculated from the X-ray output, and so on. The various temperatures will not agree. In unskilled hands they can lead to confusion but in the hands of experts they can be used with confidence.

The real problem is to handle the gas skillfully so that it is as hot as possible and is confined as long as possible each time a large burst of current is passed through the tube. Pinch devices are deceptively simple in structure and appearance, but their behavior is complicated.

In the Perhapsatron S-3 which attained a temperature of some 6 million degrees, there is good evidence that the pinch is well centered while the applied current is high. It undulates slightly, but the motion has an amplitude of only about two millimeters. These observations suggest that the discharge is well stabilized, and herein lies their great interest.

Hard work lies ahead to improve the technology step by step. The significance of the technical papers released in January lies more in the hopes they raise, than in the current state of the art. The techniques in the United States and Britain are based on the same principles but the apparatus employed is quite different, reflecting different judgments as to the most convenient way to proceed. Now, the experimenters have something to build on, something worthwhile to study.

The problems remaining are still formidable and it will be many years before we will be able to build and operate commercial reactors utilizing the deuterium of the oceans to produce electric power. Years of intensive work will probably be required to develop a laboratory thermonuclear device which will yield more energy than it consumes. After that, it will require more years to develop a full-scale power producer. Therefore, those who are apprehensive concerning the obsolescence of fission reactor plants as a result of fusion development need have little cause for concern. The controlled thermonuclear program will not interfere with the current development and construction of reactors to produce electric power from nuclear fission. In Britain also, Prime Minister Butler indicated that there would be no modification of the present plans for the civil nuclear power program based on fission reactors.

The results of research in the fusion process, however, are sufficiently encouraging and the ultimate rewards are so great as to justify the necessary expenditures of money, time and talent. THE END

Nuclear Development In Eastern Europe

By STEPHAN E. SCHATTMANN

MUCH has been written recently concerning plans for the development of nuclear power in Western Europe, particularly in connection with the formation of the Euratom community of nations. Little, however, has come to us with respect to similar plans in the Eastern European nations, hence, this brief report on nuclear developments in Czechoslovakia, East Germany, and Poland should be of interest.

Any analysis of plans to use nuclear energy for the production of electricity in the Communist countries of Eastern Europe must start from the present position of energy supplies and their future outlook. Of all the bottlenecks and shortages none is more likely to jeopardize the execution of economic plans than the energy gap. In Western Europe electricity output has been increasing at a faster rate than industrial production, but the reverse is true in Eastern Europe.

Unrealistic planning is undoubtedly the primary reason for the imbalance between industrial production and electricity production. No proper allowance was made for the time factor in constructing new power plants and the coal mining targets were fixed without regard to the miners' ability and willingness to work as intensively as the party leaders demanded. Power shortages have developed in all of these countries and existing generating equipment everywhere is operating at an excessively high rate as a consequence. All these countries have had to ration electricity. Load shedding and complete power cuts have become managers' nightmares and night work has been introduced on a large scale to change the pattern of demand.

It is against this background of mounting demand for energy and critical nature on conventional fuel resources that the expansion of the electricity industry must be regarded. While far the greater part of the power to be generated is to be produced with the help of conventional fuels, certain proportions, depending upon the countries' technological resources, are to be generated by nuclear plants. Poland, for instance, wants to increase her electricity supply from 20 million daily kwh in 1957 to 120 million daily kwh in 1972. Some 85 per cent of this total is to be produced in thermal stations, 10 per cent in hydro plants, and 5 per cent in nuclear plants.

Czechoslovakia has been badly hit by the cut in Polish coal exports in 1956. Almost all of its electricity output is produced by thermal stations. Hydro resources are limited, indeed, it is estimated that in 15 years all remaining hydro reserves will have been exhausted. Despite demands that coal miners increase their efforts, coal production will probably remain more or less static. Since coal imports from Poland may not again reach former levels for some time and since power demand is expected to increase by 10 per cent or more per year, the fuel deficit for electric power production will rise considerably *unless nuclear power becomes available*. Present

plans for additions to the Czechoslovakian power supply between 1965 and 1975 call for considerable development of nuclear power. By 1970 it is thought around one third of all electric power needed could be produced by nuclear plants.

According to East German forecasts, the coal output, consisting almost entirely of lignite with its low-calorific value, within six years will no longer be sufficient to meet the nation's power needs. Hard coal deposits are very limited and hydroelectric power resources are insignificant. Here, too, nuclear power is the answer to future power needs. Under the East German plans, twelve nuclear stations are to be built by 1970 with a total capacity of 3000 MW.

Quite apart from the necessity to bridge the gap between coal output and the demand for electricity, there is the attraction of putting coal to more profitable uses than the generation of electricity.

As far as the actual construction of nuclear power stations at the present time is concerned, the news is considerably more modest. Czechoslovakia is building her first nuclear station of 150 MW in Slovakia. It is to go into operation in 1960 and will use natural uranium as fuel and heavy water as moderator. A second station will be placed in operation somewhere between 1960 and 1965. Other stations are to be built in Slovakia and Moravia. East Germany is making a start with a station of 70 MW, which is now under construction in the vicinity of Berlin. This is to be commissioned in 1960. It will use a pressurized water reactor using both natural and enriched uranium. No details have been announced about other plants scheduled for completion by 1970, with a total capacity of 3000 MW.

Poland plans to complete her first nuclear station by 1965; its capacity is to be 200 MW, and will use natural uranium, and graphite as moderator. It will also produce plutonium. Other plants with a total capacity of 600 MW are to be constructed between 1965 and 1970. Nuclear stations coming into commission after that time are to be based on enriched uranium.

None of these countries has, as yet, the necessary training and research facilities for a large-scale nuclear program and determined efforts are being made to catch up. Under agreements concluded in 1955, the Soviet Union is providing documentation and know-how, free, as far as is known, but recipient countries have to pay for the reactors and all equipment at market prices. The Joint Institute for Nuclear Research in Dubna near Moscow, acts as a focal point, and scientists from the various Satellite countries are being trained there. The nuclear experts in Satellite countries also spend time there on research.

Czechoslovakia has made the greatest progress in setting up its own research and development organization. The Nuclear Science Institute at Rez, near Prague, to be completed in 1961, has a 2000-kw reactor which uses natural and up to 10 per cent enriched uranium, and distilled water as moderator. This reactor, which is now in operation, is used for research and for the production of isotopes. This facility also includes a cyclotron and other equipment supplied by the Soviet Union. A Faculty on Nuclear Physics has been established at Charles University in Prague. According to a Czechoslovakian delegate to the October Conference of the International Atomic Energy Agency, Czechoslovakia will probably specialize in certain branches of nuclear industry such as the study of some aspects of the reactor program and the problem of the disposal of radioactive wastes, vital to a densely populated country without access to the sea.

An East German Atomic Research Institute is in process of development near Dresden, and this is becoming the nuclear research center of East Germany. The reactor, under construction, is essentially the same as the one described by Nikolayev at the Geneva Conference in 1955. It is a 2000-kw unit using up to 10 per cent enriched uranium with a neutron flux density of about 10^{13} n per sq cm per sec. A 25-mev cyclotron and other equipment is under construction, all being supplied by the USSR.

The reactor at the Polish nuclear research institute at Swierk near Warsaw is to start operations early in 1958. Another with a stronger neutron flux is to be built between 1960 and 1965 entirely by Polish engineers. The program also includes a third reactor for testing materials. In line with the political developments which started in October 1956, Poland has been anxious to develop scientific and other contacts not only with the USSR, Czechoslovakia, and East Germany, but also with other countries, such as Britain, France, Yugoslavia, Sweden, Norway, Denmark and Switzerland. Sir John Cockcroft, Britain's leading atomic scientist, has lectured in Warsaw, and Polish scientists attended the International Conference on High-Power Nuclear Physics at University of Rochester in New York.

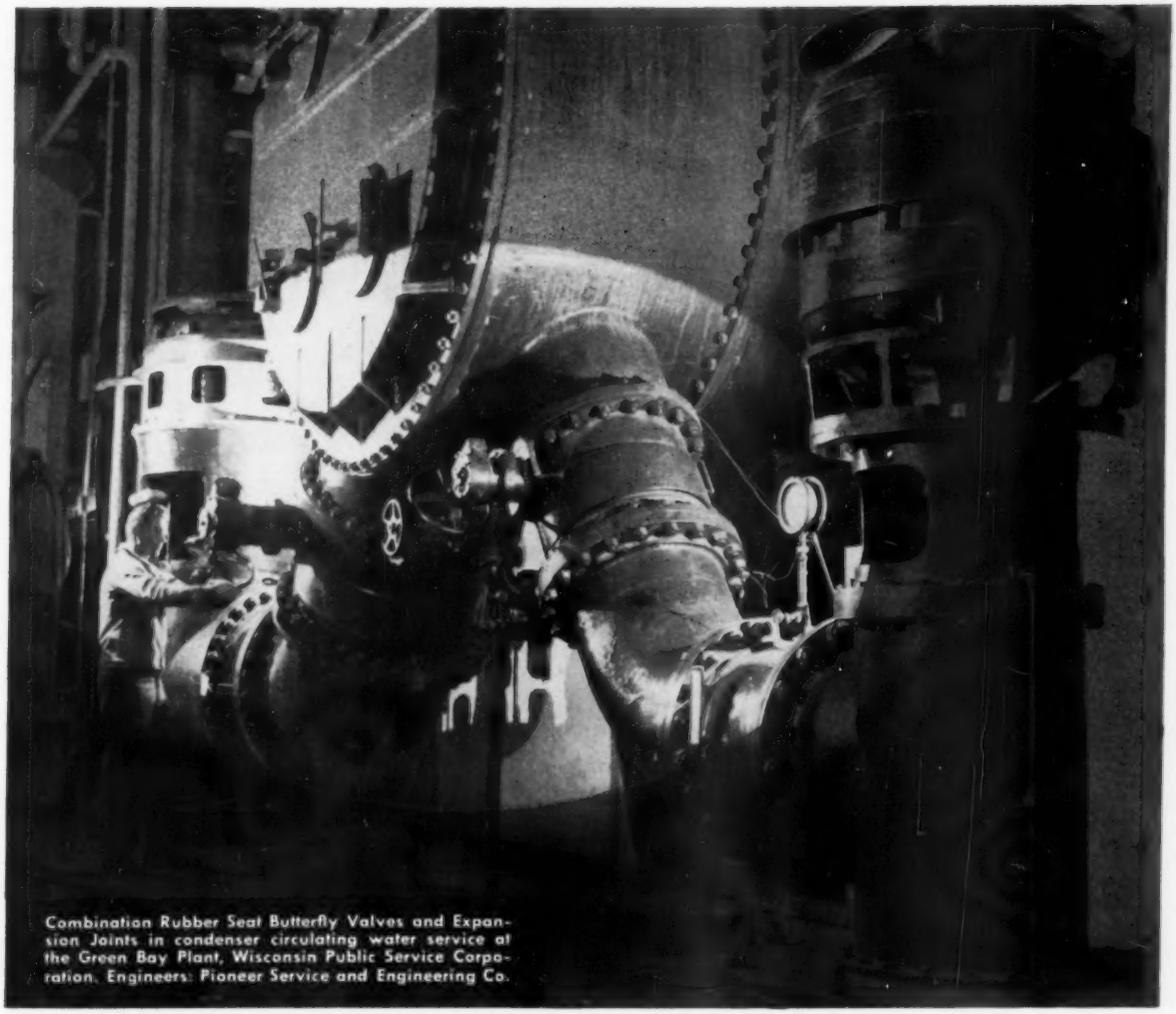
The key factor in any plan to develop atomic power is, of course, the supply of uranium. And it is in this respect above all that the tight control of the USSR over nuclear development in the communist countries of Eastern Europe is strikingly manifest. Soviet uranium resources are not of the same quality as those on the American continent and in Africa, and are not easily accessible in winter. Hence the Russians were not slow in securing deposits in Central Europe as soon as the Soviet forces entered this area after the war. While the mining operations are now by jointly-owned companies, in all cases the arrangement is that the entire output is to be shipped to the USSR. In 1957, press references stressed the fact that by selling exclusively to the USSR, East Germany and Czechoslovakia were getting better prices than could be obtained in the West. No details of actual prices or ore deliveries were disclosed but repeated references to "just and fair" made it clear that public opinion needed to be reassured.

As for mining, uranium worked in Czechoslovakia is sent to the USSR, the better quality going direct while the lower grade ores were being concentrated first. The principal deposits are in the Jachymov area where uranium was found as far back as 1789. All deposits are under effective, if not nominal control of and are worked by the Czechoslovak Jachymovske Doly Co. In recent years uranium has been found in the Horni Slavkov region in Bohemia and the workings there are among the richest in the country. Still other deposits are reported to have been confirmed in Marianske Lazne and Pribram in the western part of the country, and in Eastern Slovakia.

Before, and during the war, uranium in East Germany was being worked in S. W. Saxony and in Thuringia. Since the war, new deposits, easily workable and of good quality, have been found in the Ore Mountain region. The Wismut AG, a jointly-owned Soviet German company with an estimated labor force of 80–90,000 workers is producing about 150 tons of pure uranium a year.

The center of the uranium mining in Poland is Kowary in Lower Silesia, but intensive prospecting is going on throughout the country. Specialists and equipment as in the case of the other two countries is being provided by the USSR.

While these development programs are of a limited character compared with projects in Britain and the Euratom countries, it is questionable whether even these limited plans have prospect of being realized. Probably the most important factor is the trend of the economy in general, and the progress of the electrical, engineering, and precision industries in particular. These, at present, are under severe strain, and some are affected by shortage of basic materials. Since the economies at any given moment are operating at full capacity, without any margin of reserve, new production plans for nuclear energy projects are adding to the burden. The situation is even more difficult because of the shortage of trained scientists and technologists in the 35 to 45 year group, most of whom are not regarded as sufficiently loyal to the regime. Yet, in view of the considerable effort being made to expand training facilities at universities and research establishments makes it seem likely that this particular bot-



Combination Rubber Seat Butterfly Valves and Expansion Joints in condenser circulating water service at the Green Bay Plant, Wisconsin Public Service Corporation. Engineers: Pioneer Service and Engineering Co.

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tle-neck will be broken. Again the cooperative arrangements which exist between the three countries will have some useful effect. And last, but by no means least, the communist countries of Eastern Europe are able to benefit from the fact that they are late starters. Much of the West's basic nuclear research and technological advance in reactor design, as has been admitted, is very helpful.

Admittedly, there is no justification for accepting uncritically much that is being said by Communist propaganda about the development of nuclear energy, yet, without minimizing the severe strains any progress in this field is bound to impose on already overburdened economies, it is well to bear in mind that the industrial countries of the Soviet bloc are making a determined effort to strengthen their energy basis in the long run.

How The APPR Was Prepared For Start-Up

By J. M. TOTTEN

Chief Power Engineer
Stone & Webster Engineering Corporation

THE START-UP of any kind of power plant involves close attention to many details but even greater care must be exercised when a nuclear power plant is first placed in service. Perhaps the most important difference is the much greater emphasis on cleanliness in the case of the nuclear plant. This is illustrated in the following description of the start-up of the Army's Portable Power Reactor at Fort Belvoir.[1] Although this was a prototype plant differing radically in many respects from nuclear plants previously designed and built by Stone & Webster, there were surprisingly few equipment failures or serious operating difficulties.

As is well known, in this plant heat is transferred from the reactor core to the steam generator by a primary water loop under 1200 psi. Circulation in this loop is maintained by two canned motor coolant pumps. A small expansion drum is situated above the reactor and contains electric heating elements to pressurize the primary circuit. The steam generator is essentially a U-tube closed feedwater heater. Primary coolant flows through the tubes and feed water enters the shell side and is converted into steam, then slightly superheated in a small superheating section of the tube bundle and so passes out to the secondary circuit. The latter is essentially a conventional steam power plant operating at 175 psig, 404 F. Its main components are an extraction condensing turbine generator of 2500-kw capacity, and the necessary auxiliaries.

Rigorous Cleanliness Required

Cleaning and flushing out of equipment was done in much the same manner as in a conventional plant with one important difference. The nature of this plant made necessary much more stringent standards of cleanliness. Dirt of any nature in the primary coolant system becomes radioactive and complicates the decontamination procedure which must precede any important maintenance work. Foreign matter in the system might also damage the primary coolant pumps and could be a contributing factor in corrosion of the primary system piping.

The primary coolant system was cleaned by circulating water throughout the system, dumping refilling, circulating and dumping to waste until analysis of the water showed no pick-up of solids from the piping or equipment. The secondary system, exclusive of the steam generator was cleaned by circulating pure water containing trisodium phosphate, soda ash, and a wetting agent. The water was periodically discharged to waste and fresh water added for repeated circulation.

The main condenser was cleaned separately from the rest of the system. Reagent grade chemicals were dissolved in the water in the hot well, and this was circulated through the condensate system and then discharged to waste. The reason reagent chemicals were used was to avoid the build-up of chlorides in the condensate beyond a limit of three parts per million. The chemicals contain not over 0.003 per cent chloride. During the chemical cleaning of the condenser, the treated water was heated by direct injection of steam from a temporary boiler into the hot well until the solution reached a temperature of 155 F. Temporary piping was installed where necessary in order to flush out all the branch circuits in the condensate and feed water piping.

Hand-cleaning was also employed to remove scale from the interior of the hot well. Temporary fine mesh strainers were installed in the suctions of all the pumps except the circulating water pumps. After draining out the chemically treated water, the condenser and piping were rinsed twice with distilled water.

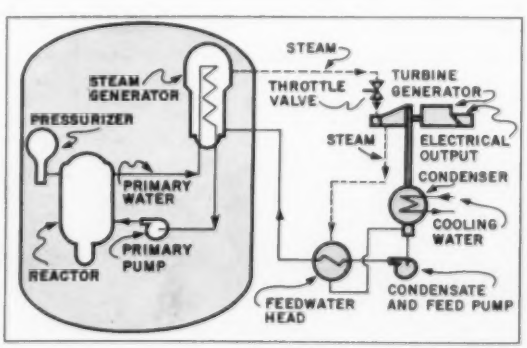
The flushing out of the steam generator was done with distilled water treated only with a detergent. After the detergent treated water was drained out, it was necessary to rinse the steam generator and piping about four times to clear out the last traces of detergent.

The cleaning of the primary system was done by Alco products employees, and they used great care in cleaning the reactor. As an illustration of what were considered to be necessary precautions, when the reactor cover was off, the workmen entering the reactor wore canvas covers over their shoes and long white coats. Their pockets were emptied and, of course, smoking was prohibited.

Borrowed Temporary Boiler

In order to pressurize the secondary system for test purposes, a small automatic oil-fired steam generator, commonly called a "jenny," was installed. This served its purpose well but was inadequate for steam line blowing purposes. So a large portable oil-fired boiler mounted on a trailer was borrowed from the U. S. Army Engineers.

This boiler was connected through a temporary pipe to the steam piping near the outlet of the steam generator and was used to blow out the steam lead to the turbine generator at full



Simplified flow diagram of the Army Package Power Reactor, showing the reactor, the steam generator and the pressurized in the containment shell

[1] Described in detail on pp 78-81 and 112 of the June 1957 issue of POWER ENGINEERING.

THE PEACEFUL ATOM

...takes a big step forward

Formal Dedication of the Sodium Reactor Experiment Marks Significant Milestone in Nuclear Power Program

On November 14, 1957, in a building high in California's Santa Susana Mountains, a group of people witnessed a ceremony of great significance not only to America, but to mankind everywhere. What they saw was the official confirmation of the success of the sodium graphite type of nuclear reactor as a most promising new method of increasing resources of usable power in a power-hungry world.

They were watching the formal dedication of the Sodium Reactor Experiment, designed and built for the Atomic Energy Commission by Atomics International. The SRE includes an experimental atomic power reactor, which achieved sustained nuclear fission in April, 1957. In July reactor heat was used to generate electricity. The SRE has been performing as planned, supplying data on the practical aspects of designing and operating a power station based on the Sodium Graphite Reactor. The power produced by the SRE is being delivered for use to the homes and factories of the nearby San Fernando Valley. It was the first electricity ever to be supplied to the American public by a private utility from a non-military nuclear reactor.

NUCLEAR-POWERED SPARK

A switch is thrown at the dedication of the Sodium Reactor Experiment—and electricity from the atom surges into the lines of a private utility company.

THE ATOM GOES TO WORK IN SOUTHERN CALIFORNIA

In the rugged Santa Susana Mountains near Los Angeles, the Sodium Reactor Experiment is showing great promise as a practical source of electric power.

Basis for Large Power Stations

Atomics International designed the SRE to give a maximum output of about 6500 electrical kilowatts. This nuclear power plant is now in operation as part of the Atomic Energy Commission's program to develop efficient types of reactors to meet the growing worldwide need for power. Atomics International will use data from the SRE to design and construct large power stations like the 75,000 kilowatt plant planned for the Consumers Public Power District of Nebraska.

The Southern California Edison Company cooperated with Atomics International by providing a generating plant to turn the nuclear reactor heat energy into electricity and by distributing the power to its customers.

Other Achievements by AI

Another nuclear power approach being conducted by Atomics International for the Atomic Energy Commission is the Organic Moderated Reactor Experiment in Idaho, which has been operating since last September. This project will provide technical information for the construction of two 12,500 kw power stations—one in Piqua, Ohio; the other in a Latin American country. AI recently completed a study for the AEC's Maritime Reactors Branch which indicated that the OMR has technical and economic promise as a power plant for atomic supertankers and merchant ships.

Another power reactor concept, the Advanced Epithermal Thorium Reactor, is under study for the Southwest Atomic Energy Associates. AI research reactors are now operating in Japan, Germany, Denmark, and the United States. Others are being built for Italy and West Berlin.

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PIONEERS IN THE CREATIVE USE OF THE ATOM

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rated speed, to test the overspeed trip and to carry a load of about 100 kw. This enabled the operators to be trained in the operation of the secondary system, and it enabled the electrical tests to be completed before operating with steam produced from nuclear energy. This use of a temporary boiler resulted in saving time and avoided the complications of trying to test out the secondary circuit with steam produced by nuclear energy.

In any modern power plant controls are centralized and before it can be operated the majority of the instruments and controls must not only be installed but the instruments must be checked for accuracy and calibrated as required and the controls must be tried out and if not ready for automatic operation they must be available at least for remote manual operation. The APPR plant was no exception in this respect.

During preliminary operation a "dummy" core was installed in the reactor; after the reactor was brought up to normal operating pressure exhaustive tests of the control rod drives were conducted to make certain that control of the reactor was completely reliable i.e., that the control rod and rod drives operated consistently and free from any suggestion of sticking. This required very careful adjustment of the clutches, position indicators, seals and other parts of the mechanism.

Many instruments and controls usually found in a fossil fuel fired plant were not needed for this plant; however, there were many other instruments which could have no place in a conventional plant. For example, there were five recording area monitors and three indicating type and one recording type operational monitors with necessary alarms to detect and measure radioactivity in the air, and water in both primary and secondary systems.

Instead of a fuel oil tank, which to contain the equivalent potential of the reactor core would hold 385,000 bbl of No. 6 oil and would be 100 ft in diameter, and 274 ft high, there is a fuel vault about the size of the bathroom in your home.

Encountered Few Difficulties

There were surprisingly few equipment failures or serious operating difficulties. The original vertical circulating water pump motor bearings failed and replacement bearings failed before it was discovered that the bearings had been mounted with no allowance for motor shaft expansion. After correction the bearings operated satisfactorily.

The hollow metal float in the distilled water tank stuck near its topmost position. This was freed. It does indicate that rollers mounted on the float and traveling on the central guide post would be a distinct improvement.

Ironically enough, shortly before the dedication date insulation on the generator field pole windings failed. Temporary repairs were hastily made in time to avoid an embarrassing postponement of the dedication ritual. The generator rotor following the repairs was out of balance and this was not corrected until after the dedication.

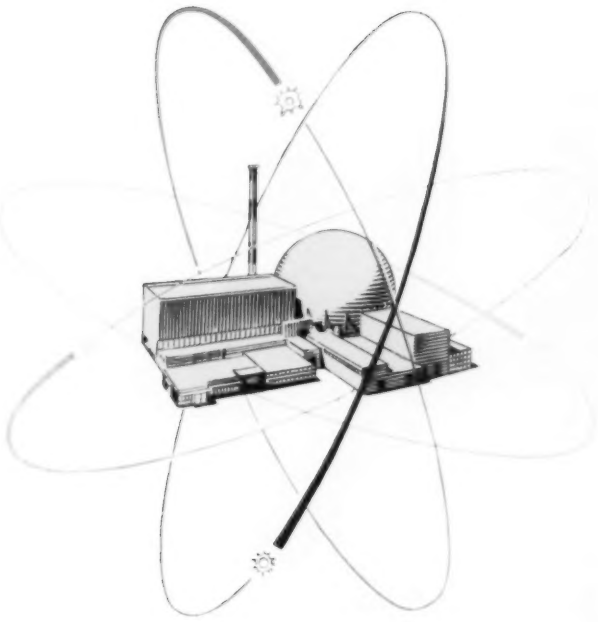
High moisture content in the steam from the steam generator had been a troublesome problem at all loads above 1750 kw. More efficient separating devices now have been installed in the steam generator.

One of the primary coolant pumps when first operated produced a light ticking noise. Upon dismantling it a slight dent was found in the pump impeller shroud; this was easily corrected.

The lubricating oil cooler piping contained adherent rust and it was necessary to mechanically rap the piping to get it clean during oil circulation. As is customary, after oil circulation was completed, the system was drained and the reservoir was cleaned manually.

New Nuclear Literature

FIRST, and foremost among last month's publications issued by the Government, is the *Twenty-third Semiannual Report of the Atomic Energy Commission*, dated January 1958. This 463-page report containing the multitudinous details of the AEC's operations during the last six months is worth anybody's serious attention. Much of it makes extremely interesting reading. It can be obtained from the Supt of Documents, U. S. Govt Printing Office, Washington, D. C. * * * For those concerned with the really technical details of nuclear development the two issues of *Technical Progress Review* issued in December, 1957 and February 1958 respectively should be very valuable. These quarterly reviews are being issued by the AEC on a number of different branches of nuclear development. The one issued in December is the first report on *Power Reactor Technology* and the one issued in February is the first report on *Reactor Fuel Processing*. These reports are prepared by experts in the respective fields and serve to acquaint engineers and scientists with the latest progress in each field. These quarterly reports are available on subscription for $2.00 per yr, domestic; $2.50 foreign; 55 cents per copy, through Supt of Documents, Govt Printing Office. * * * Not particularly new, since it was issued in April 1957 but we just got around to reading it, is another AEC publication, *Neutron and Gamma Irradiation Facilities*. This is another volume in the AEC's Nuclear Technology Series. It is a 79-page book illustrated with drawings and charts, and provides a compact reference source on nuclear radiation facilities in the U. S. Compiled by Fred Minuth and John Martens of the Argonne Nat. Lab., it describes 40 irradiation facilities operating now or expected to go into operation soon. A splendid book. It is paper bound and may be purchased for 60 cents from Supt of Documents. * * * *Control Over Source and Special Nuclear Material* (TID-7537-Pt 2) is a compilation of papers presented at a symposium held in New York, March 5-7, 1957. It contains information on such things as AEC pricing policy and billing procedures, material control procedures used during the EBR fuel fabrication, control in the processing of spent reactor fuel. There is considerable interesting information on measurement and instrumentation. Available from the Office of Technical Information, Dept of Commerce, Washington, D. C. at $3.00 per copy, * * * Anybody interested in the *Economics of Atomic Energy* from a world wide standpoint will find Mary S. Goldring's book by that name interesting and easy to read. The author lives in London and she discusses critically the growth of Britain's nuclear power from the viewpoint of one who is well informed, yet outside and, therefore, free from the trammels imposed by either membership of the U. K. Atomic Energy Authority or Commercial organizations. Chapter 2 presents a very simple explanation of some of the basic elements of nuclear science. Published by the Philosophical Library, 15 East 40th St, New York, N. Y. Price $6.00 * * * From the Louisiana State University Press comes a volume which blueprints the coming Atomic Age in the South (The South of U. S., of course) from the present until 1975. Convinced that the economic future of the South lies at the heart of the atom, the Southern Governors delegated the Southern Regional Education Board to prepare this business-like study. A major feature of the book is its striking plan for an interstate compact for nuclear development. Valuable coverage is also given to a variety of nuclear projects of Southern industrial groups and to the thorny problem of educating scientists and technologists. It was edited by Redding S. Sugg, Jr. Published by Louisiana State University Press, Baton Rouge, La. Price $3.50.



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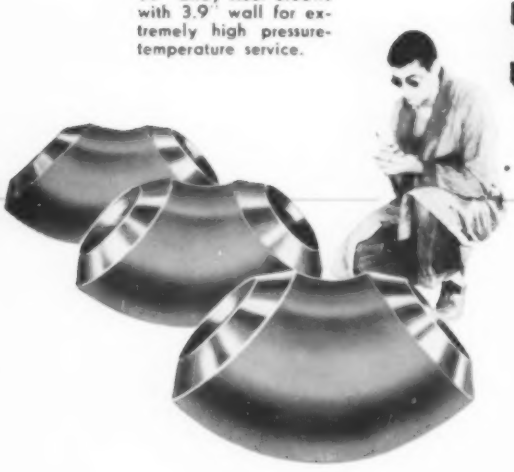

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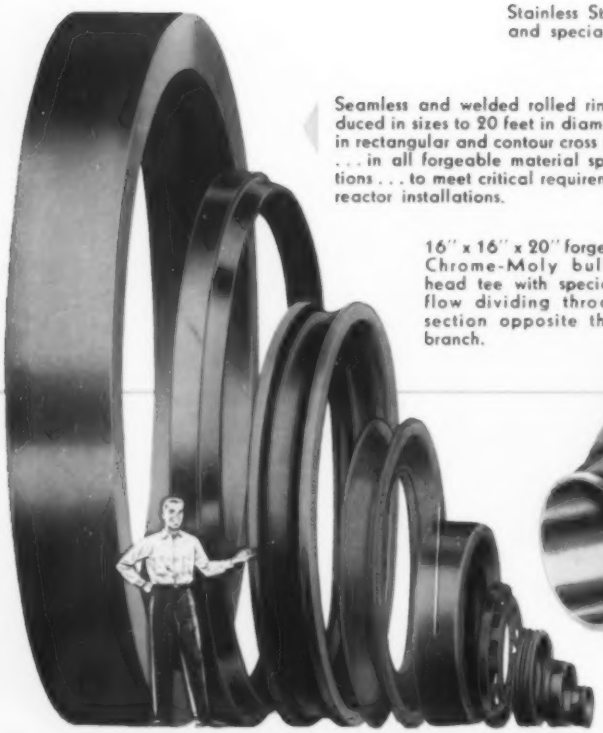

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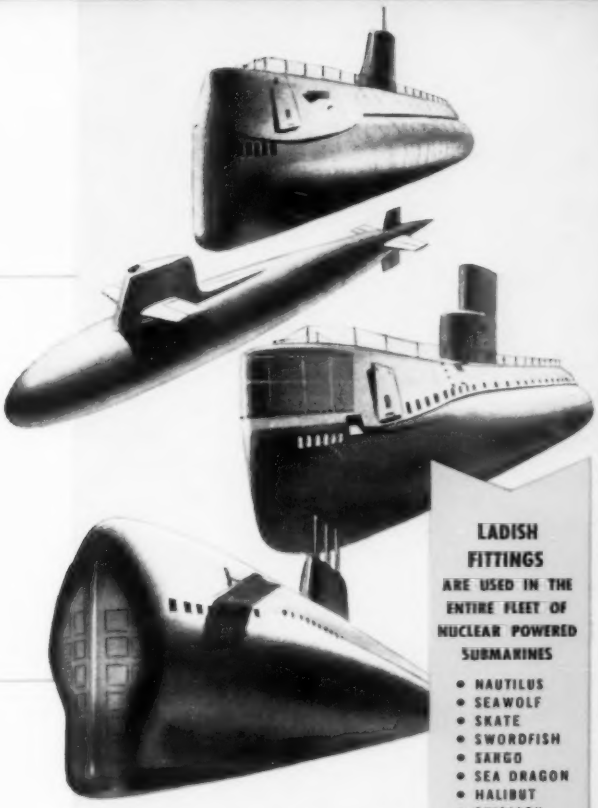

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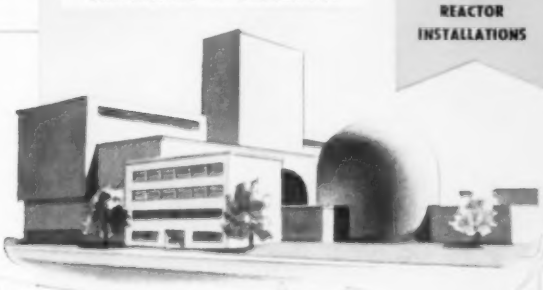
LADISH CONTROLLED QUALITY FITTINGS IN A.E.C. NUCLEAR REACTOR INSTALLATIONS



THESE AND OTHER FITTINGS ARE PRODUCED BY LADISH TO MEET THE UNUSUAL REQUIREMENTS OF MODERN POWER GENERATION.

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Division, Ladish Co., Los Angeles, Calif.
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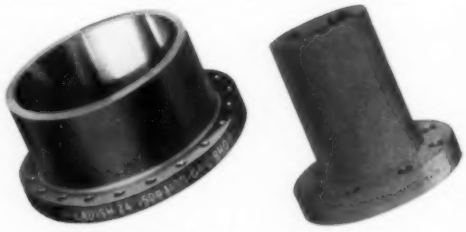
LARGE O.D. and TEMA FLANGES—
Up to 20' in diameter



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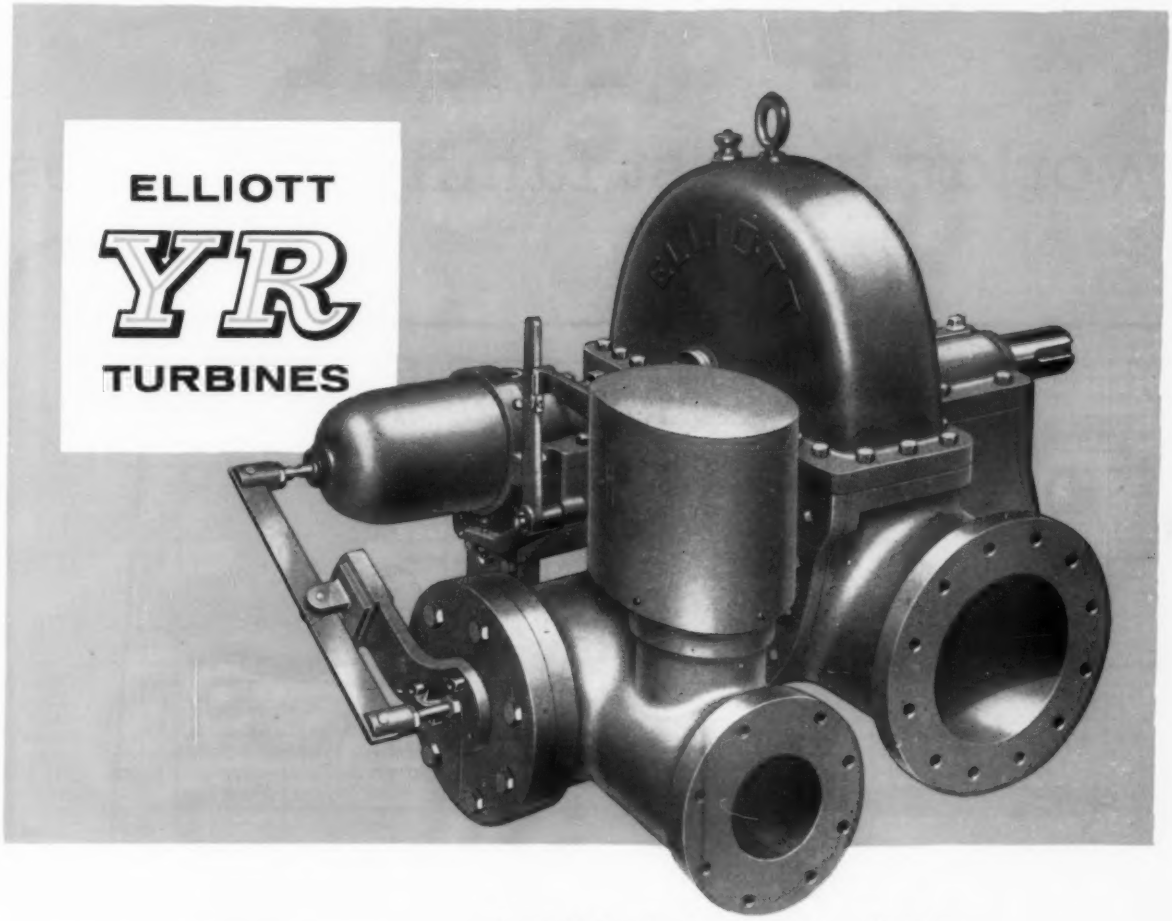
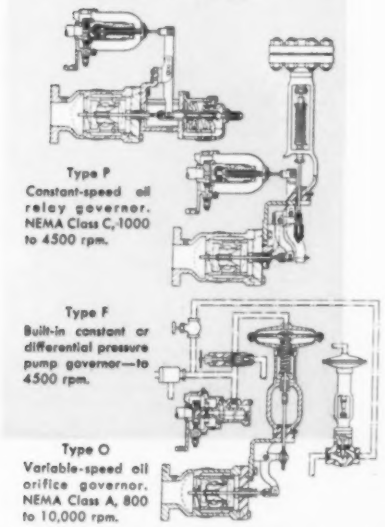


YOUR CHOICE OF DESIGN MODIFICATIONS TO MATCH YOUR SPECIFIC APPLICATION REQUIREMENTS



Type P
Constant-speed oil relay governor. NEMA Class C, 1000 to 4500 rpm.

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Built-in constant or differential pressure pump governor—to 4500 rpm.

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Variable-speed oil orifice governor. NEMA Class A, 800 to 10,000 rpm.

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Other design benefits of Elliott single-stage turbines are easy inspection . . . simple replacement of wearing parts . . . and interchangeable components from one turbine frame to another. And always near you is your Elliott field engineer. For full details write Elliott Company, Steam Turbine Department, Jeannette, Pa. Ask for Bulletin H-22B.

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HB-1

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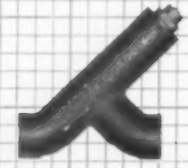

Fig. 1365A—Small Steel Pressure Seal "Y" Check Valve for 1500 pounds W.S.P. Socket weld ends. Sizes ½" to 2". Also available for 2500 pounds in sizes ½" to 3".

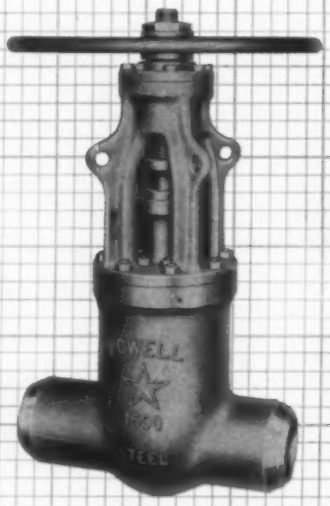

Fig. 11303—Steel Pressure Seal Gate Valve for 1500 pounds W.S.P. The higher the pressure within the valve the tighter the seal at body-bonnet joint. 600, 900, 2500 pound valves can be furnished.

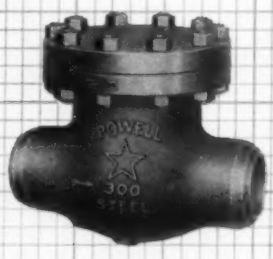

Fig. 3061A WE—Newly designed Steel Swing Check Valve for 300 pounds W.S.P. Has straight flow through area when disc is in wide open position.

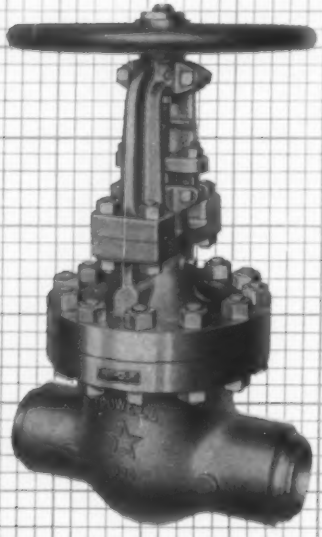

Fig. 9003 WE—Steel Gate Valve for 900 pounds W.S.P. Outside screw rising stem and yoke. Solid wedge disc. Steel valves are available for pressures from 150 through 2500 pounds.

Fig. 512—Small Bronze Gate Valve for 150 pounds W.S.P. Inside screw non-rising stem. Solid wedge disc. Can also be supplied with flanged ends.

Fig. 1444—Large Iron Body Bronze Mounted Gate Valve for 125 pounds W.S.P. Outside screw rising stem and yoke, double wedge disc. Also available with solid wedge disc.

NO MATTER WHAT your flow control requirements, Powell offers more kinds or types of valves, available in the largest variety of metals and alloys. Powell distributors, located in all principal cities, maintain inventories to fill almost any need. For special engineering problems, write direct to:

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HELPFUL BULLETINS

PUMPS AND COMPRESSORS

101 Boiler Feed Pumps — Eight-pp Bulletin 65 discusses relative merits of centrifugal and turbine regenerative type boiler feed pumps. Design features and advantages of company's turbine boiler feed pumps are detailed and illustrated. Table of pump characteristics is included, as well as performance table and other data. Fred H. Schaub Engineering Co.

102 On Glassed Pumps — "It's What's Inside that Counts" is a 16-pp booklet on glassed centrifugal pumps. Includes brief history of the development of this pump and answers to over 30 frequently asked questions about it. These cover corrosion resistance offered, mechanical design and application. Goulds Pumps, Inc.

103 Multi-Stage Compressors — Bulletin 150, 64 pp, presents company's multi-stage centrifugal compressors in both horizontally-split and vertically-split types. Advantages, construction features and application of each type are covered, and text is illustrated with photos and cutaways. A section of general information discusses fundamentals of centrifugal compressors and drivers for them. Also included are engineering data and performance characteristics. Clark Bros. Co.

104 Air Compressors — Bulletin SG-1 describes unit-type and stationary-type air compressors manufactured by the company. Photos and descriptive data on seven basic models are given, along with information on design, speeds, methods of lubrication, and working capacities. Le Roi Div., Westinghouse Air Brake Co.

HEATING

105 Instantaneous Heaters — Bulletin IW-34, 8 pp, features indirect type instantaneous water heaters, their application, selection and installation. Covers advantages of indirect water heating, methods of determining available boiler capacity, estimating hot water demand, and includes example problems, typical heater installations, selection tables. Bell & Gossett Co.

106 Cabinet Heaters — Sixteen-pp Bulletin 9617 describes company's redesigned line of cabinet heaters and their features of construction. A pictorial reference guide shows 43 possible mounting arrangements. Tables of steam capacities for 14 models and of hot water capacities for 21 models are included. Also provided are Btu correction factors for hot water and steam, cfm conversion factors, other data. Schematic drawings show four piping installations. American Blower Div., American-Standard.

MECHANICAL POWER TRANSMISSION

107 Power Transmission Equipment — Bulletin 7900-B1P, 12 pp, is designed as a general catalog on mechanical power transmission equipment. Contains selection charts for heavy duty QD sheaves, light weight and QD Junior sheaves, V-belts, and variable speed drives, including all-speed drives, motor drives, and a line of motor pulleys. Worthington Corp.

108 Gears, Speed Reducers — Latest information on stock gears, speed reducers, sprockets and chains, flexible couplings, universal joints, collars and pillow blocks is presented in 80-pp Catalog 100. Special charts for selection of speed reducers and stock gears allow choice to be made simply and easily. Another feature is the use of color coding. Individual sections are assigned distinctive colors and a color-key appears on front cover for quick location of material. Charles Bond Co.

109 Variable Speed Drives — Twelve-pp Bulletin 550 describes principle of operation, features and operating advantages of company's variable speed drives. Selection tables are included along with dimensional diagrams. Graham Transmissions Inc.

110 Heavy Duty V-Belt — This illustrated bulletin describes Condor LS V-belt for long center, heavy duty drives and featuring a precision proportioned construction reported to eliminate V-belt whip and turn-over that leads to belt failure. Advantages of design and construction are detailed. Manhattan Rubber Div., Raybestos-Manhattan, Inc.

111 Electric Brake Application — Bulletin GET-2770, 8 pp, provides detailed technical data on the application of company's complete line of a-c and d-c brakes. Applications, performance, operation and characteristics of solenoid-operated, Thrustor-operated, and magnet-operated brakes are discussed. In addition, 16 performance curves are included. General Electric Co.

112 Bearing Units — Catalog Bu-101-A, 12 pp, illustrates and describes company's line of bearing units, consisting of pillow blocks and flange blocks. Advantages are detailed and comparison charts, specifications and dimensional diagrams are included. Browning Mfg. Co.

DUST, FUME CONTROL

114 Dust Collector — Bulletin A-9157, 6 pp, describes and illustrates company's line of wet and dry type dust collectors and auxiliary equipment, including cyclones, centrifugal and dynamic washers, dust and fiber filters, discharge gates, others. Typical applications are illustrated, and details of design shown. The Ducon Co., Inc.

115 Hot Gas Washer — Bulletin L-2 describes a single-unit hot gas washer designed to eliminate most air pollution problems and resist temperatures to 2000 F. Explains how it incorporates five methods of hot gas collection in a single compact unit. Describes operation and lists six features. Specifications given for seven models in the line. Lehigh Fan & Blower Div., Fuller Co.

AIR HANDLING

116 Air Engineering — Eight-pp Bulletin 135, on air engineering for the process industries, offers a collection of brief descriptions on apparatus manufactured by this company. Covers such functions as heat removal by air method in process cooling; heat treating; refrigeration; air liquefaction; heat and moisture control; low temperature conversion, others. Apparatus includes after-coolers, air conditioners, liquid coolers, heat exchangers, condensers, others. Niagara Blower Co.

117 Guide to Grilles, Registers — Catalog 1-58 is a 54-pp selection manual on air diffusion equipment. Describes company's line of grilles and registers, including new airline grilles and registers, curved louvres and grilles and louvres pivoted at the front. Provides photos, drawings and selection tables for each of the 26 standard sizes and for the new grilles with curved louvres. Waterloo Register Co., Inc.

118 Electric Unit Ventilator — Descriptive bulletins and sample architectural specifications on company's automatic electric unit ventilator are among the new publications recently announced as available. Complete details and illustrative material included. Edwin L. Wiegand Co.

119 Heat Fans — Bulletin HF 100, 20 pp, describes features and construction components of high temperature heat fans. Performance and selection data are furnished in tabulated form, and example and explanation of engineering calculations involved in selection of heat fans is included. General Blower Co.

Do any of these catalogs answer your operating or maintenance needs? Let us know by circling the number of the catalog on the post card provided on pages 141–142. We'll do the rest!

120 Duct Design Manual — This 24-pp publication is devoted to design of ducts for air high velocity heating and air conditioning systems. Contains many performance tables, some compiled for the first time. Correct design procedure is explained by step-by-step computations on two work sheets for a multi-story building. Schematic layouts are shown. Information on duct construction and duct installation is provided. Anemostat Corp. of America.

ELECTRICAL

121 For Synchronous Performance — Bulletin 1900, 8 pp, describes the Syncro-Spede, a synchronous induction motor built in same NEMA frame size as a standard one of equal horsepower. Uses illustrated include high frequency drives, precise timing, metering and recording devices, constant speed conveyor drives. Graphs and illustrations show design principles. The Louis Allis Co.

122 Pump Motors — Totally protected pump motors, from ⅛ to 1,000 hp, are described in Bulletin B-2507. Photos

and easy-to-read copy explain component features and design and construction advantages. Reliance Electric and Engineering Co.

123 Comparative Motor Sizes — This Compar-A-Frame, Bulletin B-1284-1, gives NEMA frame assignments and overall dimensions of protected and fan-cooled a-c motors. Punched for easy insertion in notebooks, bulletin explains how to compare dimensions of Series C motors with those of the Series D line (new NEMA frame sizes). Reliance Electric and Engineering Co.

124 Special D-C Motors — Bulletin GED-3343, 8 pp, tells how company is equipped to solve special d-c motor application problems. Outlines complete engineering service, modern manufacturing facilities, and an actual case history. General Electric Co.

125 Mill Motor — Design features of company's 620 frame mill motor are detailed in illustrated Bulletin PB 9000-2. Electrical details are described, including design and construction of armature, armature coils and field coils. Mechanical design features are also covered. Elliott Co.

126 Cable Buying Hints — In easy reading style, 20-pp pocket-size Bulletin 1117 stresses importance of examining all aspects of an installation to be sure of obtaining proper electric cable for the job. Includes check list of many technical points to be covered in specifying an electrical cable circuit. Also explains the part a cable manufacturer can and should play in assuring performance of cable purchased. The Okonite Co.

127 High Voltage Cables — Bulletin RCD 701 describes Neoprene-sheathed high voltage power cables for 3- to 15-kv service. Company's ozone-resisting insulations are discussed. Also covered are advantages of Roprene sheathing, specifications, voltage ratings, scope of use. Insulation and sheath thicknesses, strandings and nominal overall diameter for ozone-resistant high voltage cables are tabulated. Rome Cable Corp.

128 Distribution Switchboard — A low-voltage distribution switchboard, which accepts any combination of six different types of protective devices, is the subject of 32-pp Bulletin GEA-6627. Lists features, application data, protective device information, system applications and selection, dimensions and guide-form specifications. General Electric Co.

129 Low Voltage Switchgear — Bulletin 6004-C, 20 pp, discusses advantages of company's line of low voltage switchgear. Includes application and selection data, curves showing short circuit currents in low voltage systems, and detailed specifications and typical switchgear assembly layout. I-T-E Circuit Breaker Co.

130 Safety Switches — This bulletin illustrates and describes the uses and advantages of company's line of Isoline safety switches featuring total safety, maximum flexibility, wide capacity and interchangeability. Total safety operation is illustrated. Electric Distribution Products, Inc., Div., Worthington Corp.

131 Motor Controls — Illustrated 56-pp Catalog 5800 features quick selector tables giving horsepower, motor speed, heater size and heater ampere ratings plus enclosure choices and prices in one easy to read table. In addition, it contains design data, prices, and ordering instructions for magnetic starters and contactors, drum controllers, pressure switches, push buttons and other motor control and pilot devices. Furnas Electric Co.

132 Individual Motor Controls — Bulletin GEA-6584, 8 pp, discusses coordinated starters for low-voltage motors up to 600 v, 1500 hp, and three phase. Describes controls for squirrel-cage, wound-rotor, and synchronous motors; cites features and applications of various starters; provides data on short-circuit protection for low-voltage individual starters; and discusses contactors, overload relays, and accessories and modifications. General Electric Co.

133 D-C Contactors, Relays — Catalog GEA-6621, 32 pp, covers general purpose contactors, mill-type contactors, time-delay contactors, general purpose relays, timing relays, instantaneous-overload relays, thermal-overload relays, field-loss relays, field accelerating and decelerating relays, and high drop-out relays. Extensive selection and application data are provided, including ordering instructions, full product descriptions, photos and pertinent technical data. General Electric Co.

134 Stationary Batteries — Twelve-pp Bulletin GB 1783 is offered to aid in selecting and installing Gould Plante batteries in switchgear, alarm systems, signalling, emergency lighting, other services where batteries are used for standby power. Engineering specifications tabulated include ampere-hour capacity, discharge rates, overall cell dimensions, weight per cell and electrolyte required. Installation data are given with recommended dimensions for storage racks. Gould-National Batteries, Inc.

135 Electrical Connectors — Bulletin 1252-1, 62 pp, features detailed information on company's line of environment-resistant electrical connectors. Two major series of connectors are described, with specifications and selection data, photos, drawings and diagrams, included. A wide choice of pin and socket contact configurations and receptacle housings for many industrial applications is listed. The Pyle-National Co.

136 Electrical Contacts — Catalog C-520, 16 pp, describes properties and applications of company's line of electrical contacts. Discussed are contacts manufactured from fine silver, palladium and nickel, silver alloys as well as silver cadmium oxides and many powdered metal compositions designated as Gibsiloys. List of applications and materials is furnished. Gibson Electric Co.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 141 and 142.

137 Thermocouple Extension Wires —Eight-pp Catalog 32 illustrates, according to insulation and construction, company's types of thermocouple and extension wires. Listed with each are identification symbols of the calibrations and gage sizes available. Charts give information on calibration symbols and wire color codes; wire resistances, weights, and electrical properties; and insulation characteristics. Thermo Electric Co., Inc.

138 Emergency Lighting — Twenty-pp Publication 243A features emergency lighting systems for commercial, industrial and other types of buildings. In addition to describing the systems, catalog contains complete information and specifications on all components, fixtures and exit signs, as well as excerpts from the National Electric Code requirements. The Standard Electric Time Co.

VALVES

140 Diaphragm Control Valves — Specification S810-16 gives details of construction on company's Series 800 three-way control valves, including both single and double-seated designs for mixing or diverting service. Includes sizes, materials, pressure ratings and cross-section drawings of body types. Minneapolis-Honeywell Regulator Co.

141 Automatic Valves — Bulletin 7F features quick-reference data on pressure reducing and regulating valves and diaphragm operated control valves. Gives easy-to-use résumé of seven different valves, including pressures, body materials, service and pipe sizes. A. W. Cash Valve Mfg. Corp.

142 Relief Valves — Catalog 110 describes company's line of adjustable, spring-actuated relief valves. Includes performance curves, complete dimensions, parts specifications, cutaway drawings and photos. Tuthill Pump Co.

143 Purge Sequence Valve — This flyer describes company's steam purge sequence valve, designed to provide a secure and hazard-free means of purging or scouring oil burner tips in industrial installations. Contains diagrams and a photo of the valve. Atlas Valve Co.

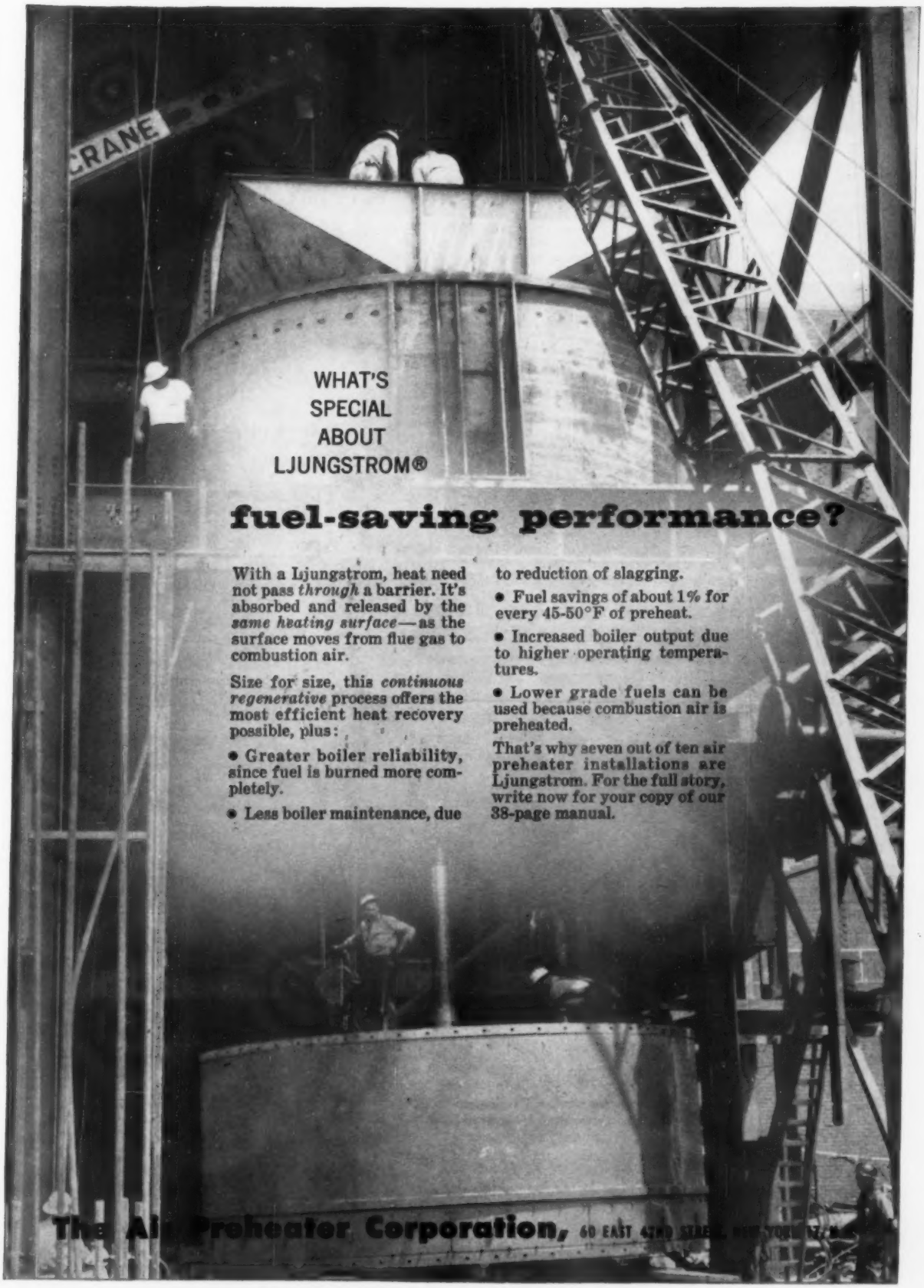
144 Valves, Controllers — Bulletin S-730-1, 8 pp, describes company's line of automatic valves and controllers, including pressure-reducing and regulating valves, relief valves, back pressure valves, controllers, control valves, differential regulators, oil pumping units, governors, combination regulators, control systems and temperature regulators. Size and capacity data included. A. W. Cash Co.

INSTRUMENTS AND CONTROLS

145 Metering, Control Systems — Bulletin 500 describes the purpose, design and operation of company's metering and control systems. A discussion of pneumatic and electric telemetering, and pneumatic control is included, along with detailed literature references for all products making up these systems. Bailey Meter Co.

146 Guide to Thermometers — Catalog C60-2, 56 pp, describes complete line of Brown rectangular case filled system thermometers. These indicators, recorders, transmitters, and electric or pneumatic control instruments are covered as to design, function, application. Vapor actuated, gas actuated, and mercury actuated thermometers and thermal systems are listed and explained, along with separable wells and other accessories. Minneapolis-Honeywell Regulator Co.

147 Data on Pyrometers — Bulletin GEA-6650, 8 pp, explains features of com-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Size for size, this *continuous regenerative* process offers the most efficient heat recovery possible, plus:
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• Fuel savings of about 1% for every 45-50°F of preheat.
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Which of these characteristics are essentials on your Remote Control Jobs?

• Accuracy . . . High Load Capacity . . . Adaptability . . . Freedom from Trouble . . . Long Life . . . Flexibility . . . these are some of the qualities of ACCO TRU-LAY PUSH-PULL *flexible* CONTROLS that have made it possible to improve the operation of literally hundreds of mechanical products (list on request). Full description of this versatile REMOTE CONTROL is given in our **DATA FILE** available for your further study.

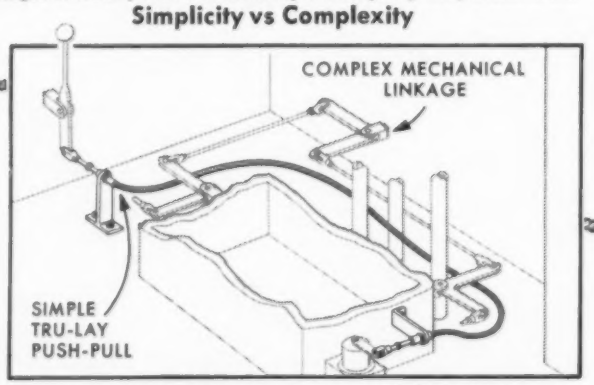
ACCURACY is inherent in the basic design, and in the standards of quality and precise dimension that control the manufacture of TRU-LAY PUSH-PULL CONTROLS. These are precision products, not gadgets.

VERSATILITY of this fine remote control can best be illustrated by citing some of the jobs it handles well . . . **HOT** jobs on jets and industrial furnaces . . . **COLD** jobs down to —70°F . . . **WET** jobs (the conduit can be completely immersed) . . . **DIRTY** jobs . . . **ABRASIVE** jobs . . . **CORROSIVE** jobs . . . **HEAVY, TOUGH** jobs up to 1,000 lbs. input . . . **LIGHT DUTY** jobs . . . **REMOTE** jobs 150 feet or more from the control point. These units are frequently and successfully used in conjunction with electric, hydraulic and air controls . . . are thoroughly effective under almost any operating condition.

"Solid as a rod but *flexible as a* wire rope" aptly describes TRU-LAY PUSH-PULL CONTROLS. This flexibility provides positive, remote action whether anchorages are fixed or movable . . . it damps out noise and vibration . . . protects delicate instruments . . . it permits ease of handling and shipping even when assemblies are 100 or 150 feet long . . . it avoids the risk of damage always present with solid tubular controls that must be preformed to position . . . and flexibility greatly simplifies installation of controls by reducing the number of working parts and by making it possible to snake around obstructions.

Advantages of Tru-Lay Push-Pull flexibility and simplicity are pictured below

Simplicity vs Complexity



Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased back-lash, lost accuracy and vibration rattles.

• Whether your interest is in a single application of this versatile PUSH-PULL CONTROL, or in its inclusion as a component of the product you manufacture, the six booklets and bulletins in this **DATA FILE** will answer your further questions, and will also provide you with the means of defining to us the applications you may be interested in.

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pany's pyrometers with emphasis on such design features as printed circuits, lead length compensation. Standard scale ranges are listed. Includes application information on control forms, principles of operations of the basic instrument and controller. General Electric Co.

148 Secondary Instruments — Eight-pp Sup. Bulletin 380-L3A describes secondary instruments and accessory devices for changing the Propeloflo Meter from a basically totalizing unit to one suitable for any combination of remote totalizing, indicating, and recording functions, or for batch measurement of liquid flows. Shows accuracies, applications, principles of operation and other pertinent data; also contains line drawings, photos, capacity charts. Builders-Providence, Inc., Div. of B-I-F Industries, Inc.

149 Electrolytic Hygrometer — Bulletin EH-4001 provides detailed information on features, operation, and specifications of company's portable, panel-mounted, and explosion-proof models of electrolytic hygrometer. The literature is illustrated with photos, flow diagrams, and dimensional drawings. Process Instruments Div., Beckman Instruments, Inc.

150 Feeder Control Systems — Methods of automatically controlling concentration of chemical additives are the subject of 8-pp Bulletin B-I-F P7. Contains schematic diagrams of 10 typical control and proportional pacing arrangements from remote-control rate setting to self-checking and self-regulating systems. Omega Machine Co.

151 Tank Gaging Systems — Bulletin 463A describes a line of remote and direct reading tank contents gaging systems. Advantages of the various gages are detailed and photos, drawings and a list of liquids successfully gaged are included. The Liquidometer Corp.

WATER CONDITIONING

153 Water Softeners — An addition to company's "Fact-File-Folder" on water purification equipment, Bulletin 57-1 contains detailed information on their line of custom-engineered water softeners. Softener specifications are included. H. M. Mueller Corp.

154 Zeolite Softeners — Bulletin 5763, 12 pp, describes advantages of company's zeolite water softeners. Design and construction features are detailed and selection data presented in a series of charts. A line of regeneration equipment for zeolite softeners is also described. Photos and schematic diagrams are included. General Filter Co.

155 Rust, Corrosion Treatment — A treatment for rust and corrosion in steam lines, return lines, radiators and steam heated processing equipment is described in Bulletin MA. Causes of rust and corrosion and action of the water treatment are explained. The North American Mogul Products Co.

156 Corrosion Inhibitor — Bulletin 420-12-19 describes manufacturer's Composition TG, a sodium-zinc hexametaphosphate corrosion inhibitor for water systems, stressing its superiority in controlling corrosion in water mains and cooling equipment. Provides comparative graphs showing flow coefficients, rate of film formation as determined by weight loss and current flow, and schematic drawings of

VOGT identification Disc...

...on top and in sight

makes it easy to identify valves —even in insulated lines

The Vogt tell-all identification disc, on every valve, is permanently located above the handwheel for complete and convenient identification. It shows valve size, catalog and drawing number, materials used for principal parts and primary pressure and temperature ratings. The flat on the handwheel protects the disc in assembly and in service.

Vogt GP Valves are available in a complete range of sizes from ¼" to 2", with HAYNES STELLITE* faced seating surfaces and rated 800 pounds at 850° F. and 2000 pounds at 100° F. (Other types are available through 8" size.)

*Trade-Mark of Union Carbide and Carbon Corporation

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Vogt GENERAL PURPOSE GP Vogt FOR BETTER VALVES

DROP FORGED STEEL VALVES

Adv. No. 7 in a series describing the features of Vogt GP Valves.

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Quiet, Efficient, Convenient

Ideal for Hospitals, Hotels, Apartments, and Industries where noise is objectionable.

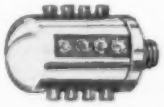
Rotojet Electric Tube Cleaner thoroughly cleans straight tubes from 25/32" to 4" I.D. in boilers, condensers, evaporators, and heat exchangers so quietly that it can be operated without disturbing anyone.

This self-contained unit comprises a powerful motor, rotatably mounted on a stand, a required length of heavy duty flexible shaft, a 20 ft. cable, and a selection of heads, brushes, drills, and scrapers to meet any cleaning need. The motor swivels and rotates so that tubes on top, bottom, and sides can be cleaned without moving the unit. A few of the many types of heads available are shown below.

Bulletin 107 gives full details of this quiet, efficient, convenient tube cleaner. Send for it now.

Rotojet Electric Tube Cleaner with swing-frame head.

4-way drill and universal coupling.



Expanding wire brush.

ELLIOTT COMPANY – ROTO PLANT
Tube Cleaner Specialists Since 1910
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feeding methods. Calgon Co., Hagan Chemicals & Controls, Inc.

TUBING, FITTINGS

157 For Process Industries — Sixteen-pp Booklet TB-417 presents information on application of tubing, pipe and welding fittings for process industries. Gives points to consider in selection of materials, analysis, physical, mechanical and creep strength properties of various steels and case histories of cost saving applications of company's tubular products. Tubular Products Div., The Babcock & Wilcox Co.

158 Tubes and Plates — Publication B-2, 46 pp, covers the subject of tubes and plates for condensers and heat exchangers. Fields of application and particular problems encountered in each are described. Information on condenser tube alloys, plates for tube sheets and baffles, manufacturing methods, installation, operational factors affecting tube life, corrosion factors in condenser tube service is presented. A section of physical properties and tabular data is included. The American Brass Co.

159 Welding Fittings, Flanges — Bulletin FB-503 is designed as a guide to buying welding fittings and flanges. Explains how to go about specifying welding fittings and flanges required. Tubular Products Div., The Babcock & Wilcox Co.

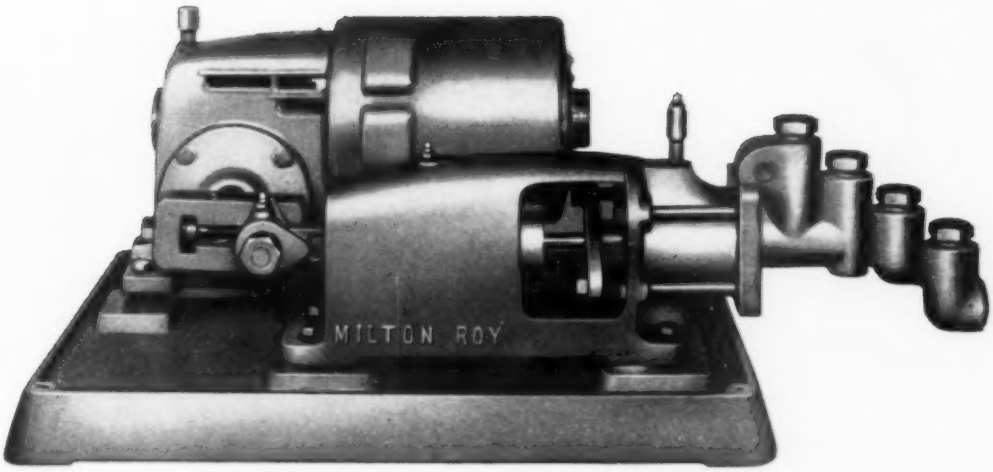
OTHER EQUIPMENT

160 Packings, Gaskets, Seals — Bulletin AD-162 is a 12-pp packing handbook detailing packings, gaskets and seals and their materials of construction and uses. Contains a table listing effect of numerous gases, liquids and solvents on packing materials from metals to synthetics to leather. Booklet is divided into three sections, the first dealing with static sealing. Another section covers dynamic sealing for rotating and reciprocating service. A third section outlines Teflon and Kel-F materials. The Garlock Packing Co.

161 Quick Coupler — Eight-pp Catalog F-10-R gives complete information on Kamlok quick couplers, used on hoses, piping, and equipment. Describes features, applications, materials, styles and sizes. Contains dimensional drawings, pressure-temperature ratings, and useful chemical service recommendation chart. Jordan Industrial Sales Div., OPW Corp.

Bulletins reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

162 Electric Hoists — Bulletin E-58, 24 pp, lists six types of electric hoists, including lug suspension, plain trolley, geared trolley, 4-wheel motor driven trolley, variable speed motor driven trolley and close headroom units with lifting capacities of ½ to 10 tons. Construction features of internal mechanisms are explained through cutaway diagram. Funda-



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Patented Step-Valve liquid ends provide precise metering of chemicals . . . corrosive, viscous, or slurry solutions are handled with an accuracy of plus or minus one percent. Air binding can't occur because there are no pockets to collect gases.

This flexible unit is adaptable to manual or automatic control of capacity . . . has capacities from 3 milliliters to 2700 gallons per hour against pressures to 25,000 psi.

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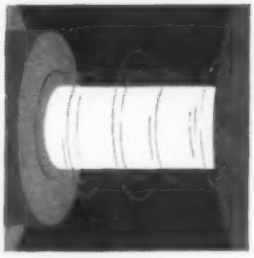

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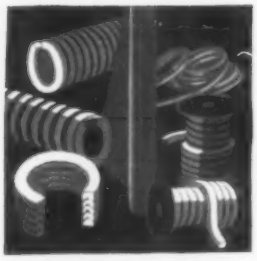

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mentals of operation, duty cycle formulas, outline dimensions, weights, types of reeving, and other data included. Wright Hoist Div., American Chain & Cable Co., Inc.

163 Centralized Lubrication — Application of centralized lubrication to industrial machines is detailed in 12-pp Catalog 34-28A. Analysis of machine bearings is among subjects discussed, as are selection of lubrication interval, selection of system components, selection of lubricant, installation procedure. Alemite Div., Stewart-Warner Corp.

164 Fire Protection Service — Form 5742 describes a "service plan" for fire fighting training and fire prevention planning. Describes such services available to users of company equipment as in-plant fire protection survey, visual aids for training meetings, fire control training and demonstrations, fire school for supervisory personnel. Ansul Chemical Co.

165 Power Actuators — Bulletin B-50-3, 12 pp, describes pneumatically positioned power actuators used in the process industries for throttling control service. Advantages of design and operation are fully detailed, applications are illustrated, and specifications, dimensions, photos and diagrams included. Conoflow Corp.

166 Diesel Engine Fuel — What diesel engine users should know and look for when selecting engine fuel is outlined in this 16-pp illustrated booklet. Points out effects of various grades of fuel on diesel engine life and performance, and includes fuel selection chart. Detroit Diesel Engine Div., General Motors Corp.

167 Industrial Stack — Detailed information on a permanent, low cost refractory smoke stack for commercial and industrial applications is contained in 8-pp Bulletin IS-32. Gives product information, applications with boilers, furnaces and incinerators, installation methods, mechanical specifications and test data. Van-Packer Co., Div., The Flintkote Co.

168 Why Stainless-Clad Steel — Advantages of stainless-clad steel for coal handling equipment are detailed in this 16-pp bulletin. Photo-stories of typical applications in hoppers, chutes, bunker noses, pipes and spreaders are included. Lukens Steel Co.

169 Using Sulfur Dioxide? — For plants in which SO_2 is used in manufacturing processes, this 16-pp booklet gives answers to questions frequently asked about this chemical. Gives physical and chemical properties, specifications and specification test methods, suggested uses, toxicity, shipping and handling procedures. Ansul Chemical Co.

170 Pyramid Ladders — Catalog 158, 20 pp, describes a line of pyramid-design step ladders, as well as hydraulic lifts and fixed or adjustable-level work platforms for above-floor working safety. Illustrates 35 new models of ladders for working heights to 15 ft, gives detailed specifications and shows typical uses. Ballymore Co.

171 Engineering Services — This brochure outlines company's specialization in product development for the metalworking industry, automation, metal curtain wall design, and industrial building design. Electrical transmission and distribution systems for industrial plants is another service featured. Clauer Associates.

Maybe *you'll soon have this decision to make*

LUBRICATION CASE STORY ON THE NEW WORTHINGTON AT INDEPENDENCE, IOWA

Situation: Gene Williamson, plant superintendent, had a decision to make when the Independence, Iowa, Municipal Light Plant installed a new 3600 Horsepower Dual-Fuel Worthington last year. What lubricating oil to use? Other equipment in the plant was lubricated with STANODIESEL Oil M. Performance was excellent. Lubrication technical service performed by men with experience and training for the job likewise was excellent.

What was done: The decision was made to install STANODIESEL Oil M. Now after 3,780 hours of operation, there are no regrets. There are no signs of wear.

STANODIESEL Oil M is refined from the finest-quality base stock. Additives help the oil resist viscosity change, keep engine parts clean. Other additives control foam, make it possible for oil to reach and hold protective film on even the most difficult to lubricate parts.

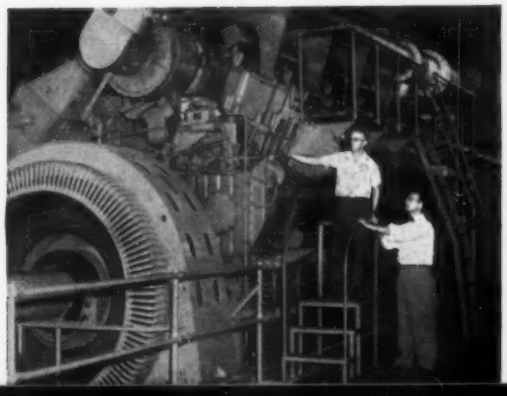
What you can do: Get all the facts about STANODIESEL Oil M from your Standard Oil lubrication specialist. There's one near you in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago 80, Illinois.**

Quick facts about

STANODIESEL OIL M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by use of economy fuels.
- Maintains film on difficult to lubricate parts.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.

You expect more from **STANDARD** *and get it!*



Running smoothly. Gene Williamson, power plant superintendent, and Standard Oil's Bob Wenger (right) check over new Worthington Dual-Fuel engine. Good lubrication technical service is one of the reasons Williamson decided upon STANODIESEL Oil M when engine was installed. Bob Wenger is well qualified by both experience and training to provide such technical service. He has been doing this work for nine years. In addition, he has an engineering degree from Iowa State and has completed the Standard Oil Sales Engineering School.

Here's a vertical turbine with

TERRY SOLID WHEEL

and all its advantages

When it comes to judging a turbine's ability to deliver in vertical service, ratings tell only half the story. It's the Terry construction refinements that give you assurance of long-range operational economy: Thrust bearing designed to absorb external pump thrusts . . . carbon ring glands specially made for vertical operation . . . casings and bearing housings split vertically for easy accessibility.

But most important, the Terry vertical turbine has an *almost* indestructible rotor. A single forging of special composition steel, it has no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

If your application demands a vertical turbine, specify Terry solid wheel. Available in capacities from 5 to 300 horsepower. And remember, the extra durability built into these vertical turbines is typical of every turbine in the complete Terry line.

For further information, send for a copy of bulletin S-137.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

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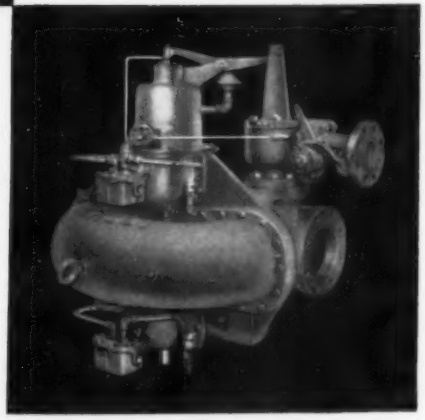

TT-1210

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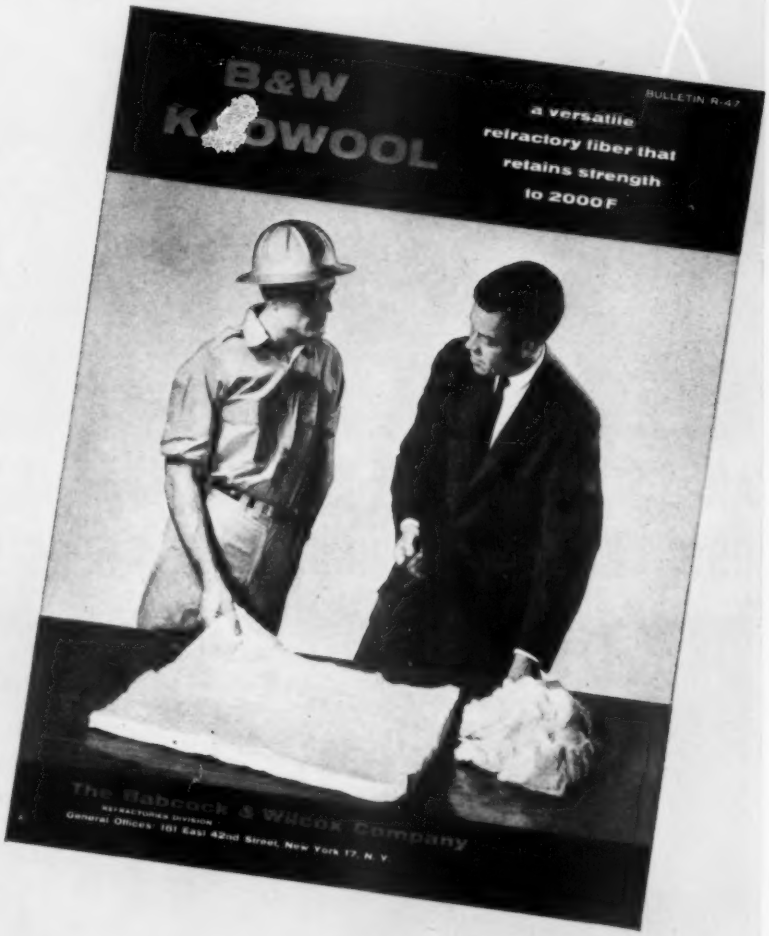
New Bulletin on

B&W KAOWOOL

Gives data on many uses of 2000 F refractory ceramic fiber

B&W Kaowool is widely used in many power plant applications. It is excellent for packing expansion joints in refractory linings as well as around headers and burner boxes. Kaowool has proved its long life when applied around inlet valves of turbo generators and the flange covers of steam turbines. Write for new bulletin giving helpful data on B&W Kaowool, the easy-to-apply ceramic fiber that withstands temperatures to 2000 F.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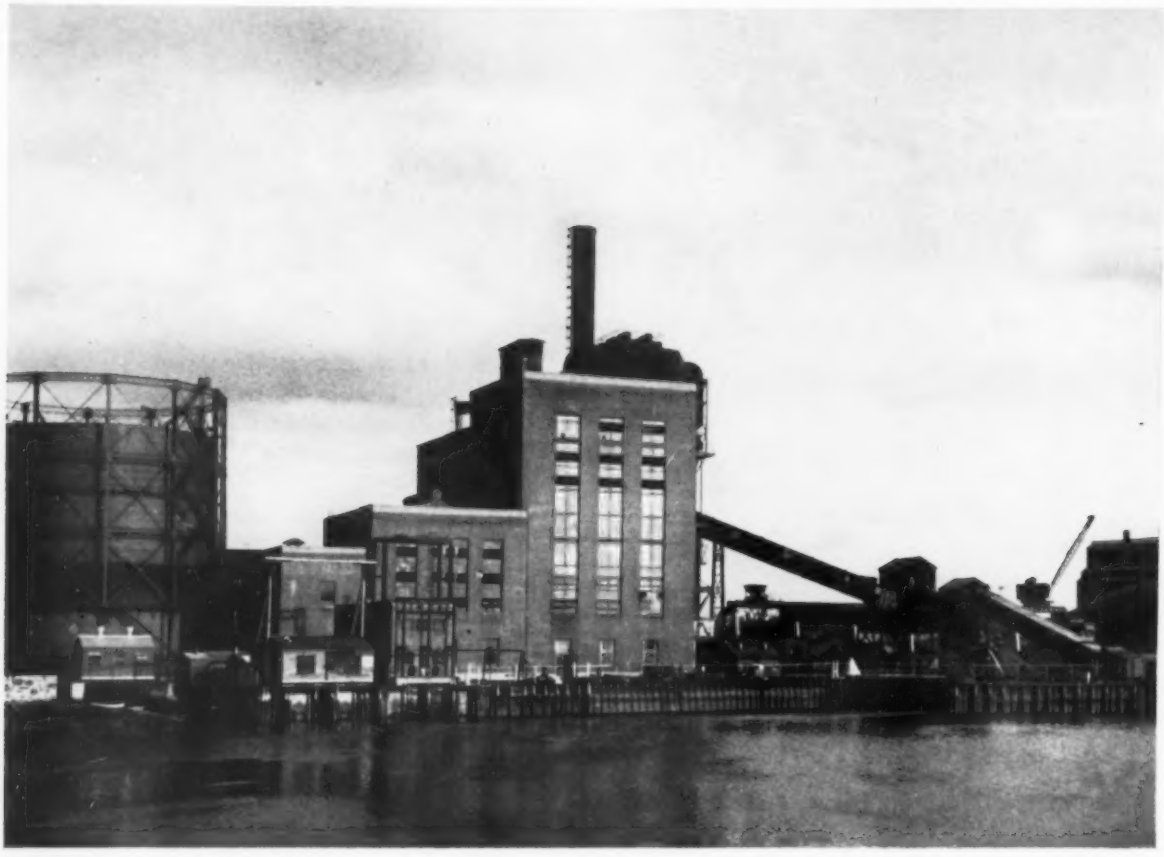
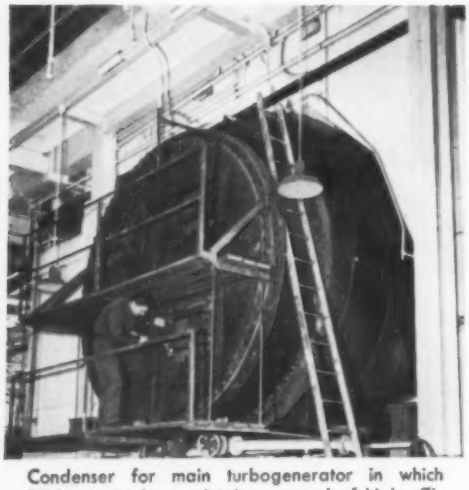


After 17 years...
99% OF ORIGINAL BRIDGEPORT TUBES STILL GOING STRONG



Condenser for main turbogenerator in which Bridgeport tubes maintain a record of high efficiency and long life.

This steam condenser tube record at a New England utility isn't often equaled. The 25,000 sq. ft. condenser in this plant contains 4,340 18-gauge Bridgeport Aluminum Brass tubes, each 22 ft. by 2⅞₂ in. In 17 years of operation only five tubes have had to be replaced.

The plant serves 100,000 people, generating a total of 65,000 kw. The condenser uses harbor salt water, filtered through half-inch mesh screening with chlorine added for slime control. The harbor water has a high ammonia content.

Tubes are Aluminum Brass—77% copper, 2% aluminum and 21% zinc—a *standard* Bridgeport alloy that, in this case, is giving *exceptional* service.

Making the exception the rule is an everyday occurrence at Bridgeport. Technical Service, research, and manufacturing techniques and facilities—all are aimed at duplicating stories like this in condenser and heat exchanger operation.

A call to your nearest Bridgeport Sales Office puts this assistance at your elbow.

BRIDGEPORT CONDENSER TUBES

Bridgeport Brass Company, Bridgeport 2, Conn. • Sales Offices in Principal Cities

In Canada: Noranda Copper and Brass Limited, Montreal

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HIGH CAPACITY PACKAGED STEAM GENERATORS

by Foster Wheeler

Series AG-200 extends economy and dependability of FW Packaged Design to over 60,000 lb/hr

To meet the needs of industrial plants for high-capacity Packaged Steam Generators, Foster Wheeler offers units for capacities of 50,000 to 63,000 lb/hr and higher, depending on operating conditions.

A modification of the proven AG-100 design which has provided industry with reliable, economical steam in the range of 10,000 to 50,000 lb/hr, these compact, space-saving units permit more steam capacity in less space than has heretofore been possible. For complete details, write to *Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.*

FEATURES:

- Final Steam Temperatures to 840 F
- Design Pressures to 900 psig
- Standard Heat Recovery Arrangements Available
- 42-inch Steam Drum
- Two Burners
- Automatic Controls
- Suitable For Indoor or Outdoor Installation
- Tangent Bare Tube Furnace Side Walls and Roof
- Staggered Boiler Bank Tube Arrangement
- Fully Drainable and Removable Superheater.

THE FOLLOWING AG-200 UNITS ARE NOW IN PRODUCTION:

Capacity lb/hr	Operating Pressure psig	Final Steam Temperature Deg. F	Feedwater Temperature Deg. F	Fuel	Efficiency	Steam Quality
52,500	400	750	200	No. 6 Oil	85.5	3 ppm Solids Carryover
60,000	285	Sat.	220	Nat. Gas	78.3	3 ppm Solids Carryover
63,700	150	Sat.	225	No. 6 Oil	83.7	0.5% Moisture Carryover
68,000	620	Sat.	350	No. 6 Oil	80.9	1 ppm Solids Carryover

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

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WELBOND®
is the valve
for high pressures
for high temperatures

Welbond Valves are winning acceptance among modern steam plants for all high pressure, high temperature valve service.

Superheater vents and drains, water wall drains, water column emergency shut-off, strainer blow-off, economizer drains—are just a few places where Yarway Welbond Valves are proving their mettle.

These special Welbond features insure improved valve performance:

- **Stem** of 321 stainless steel, used with special **packing** to prevent stem corrosion
- Easy and quick **accessibility.** All working parts removable through yoke. Jack action of stem forces out old packing
- Non-distorting, thermally-compensated **seat**
- Ventilated, easy grip **handwheel**
- **Streamlined flow** through body

For full information, ask your Yarway man or write for Bulletin B-452.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

Yarway Welbond Valves are available in nine sizes, ¼" to 2½", angle and straightway designs. Pressures to 2500 psi, temperatures to 1050° F.

YARWAY WELBOND ... *a good way to specify high pressure/high temperature valves*

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TRACERS

Power Engineering's Monthly Probe of Power Facts

Economical new way of returning eroded superheater tubes to their original condition has been worked out by Central Power Electric Co-op in North Dakota. It's spray-welding, or metallizing of the tubes in place in the boiler. Saving in cost over installing new tubes is phenomenal. Ernest Wicklund tells how and why on page 103 of this issue.

Testing has been going on for a year on the country's first cross-country coal pipeline. This runs 108 miles, from Pittsburgh Consolidation Coal Co's plant near Cadiz, Ohio, to Eastlake Station of Cleveland Electric Illuminating Co. Preparation problems have been intricate, especially in connection with grinding and screening, underwater coal storage and recovery. At the discharge terminal, less serious problems were encountered in slurry de-watering. Pipeline itself and the related high pressure pumping equipment have proved entirely successful from the start. Commercial operation of the pipeline is expected by June.

Gas turbine seems to have arrived as a major prime mover for electrical production. Z. Stanley Stys of Brown Boveri, at AIEE's Winter Meeting (see page 96 this issue), states that it is ultimately possible even to build a 100,000-kw unit which will have about the same space as a 20,000-kw unit and work on the principle of a combined steam-turbine and gas-turbine cycle, where the steam is generated at supercritical conditions. Efficiency of over 45 per cent seems feasible.

General Electric claims a broad advance on the insulation front with a new type of turbine-generator bar ground insulation. Used and improved over the past four years on large G-E generators, the insulation has mica mat as the predominant dielectrical material, modified-epoxy resins as binding and impregnating agent, and woven glass tape as the supporting member. Result is a physically much stronger and tougher system.

Raytheon has been using a class of materials known as perfluorinated compounds to reduce size and weight of electronic-type transformers as much as 75 per cent. In the form of inert liquids and gases these compounds are used as coolants in transformers built to operate at temperatures of up to 200 C (392 F). Three years of testing have proved the compounds to be good heat-transfer agents and that they make possible less bulky transformer designs.

ZETA, Britain's high power device used in thermonuclear research, which has already done 6,000,000 F, is expected to attain a temperature of around 25,000,000 F with the present apparatus, and double that figure is predicted. For progress in controlled thermonuclear reactions both in the U. S. and Britain, see ATOMICS, this issue, page 44.

What does the competitive requirement of producing electricity at 8 mills per kwh in the U. S. mean in terms of nuclear power operations? According to F. L. Culler, Jr of Oak Ridge National Laboratory, it means that the cost of recycling fuel must not exceed 0.75 mills per kwh for reactors that cost $250 per kw of installed capacity.

Photos courtesy Commonwealth Edison Co.

1 During the 90 days of his trial period, the new man learns his way around the plant by doing simple jobs under close supervision. Here Ray Wilkinson (left) shows Bob Ehnert the mysteries of the furnace wall soot blowers

Training New Men for Power Plant Work

What's the best way to do it? Here's a review of how Commonwealth Edison Company of Chicago gets results in selecting and inducting beginners into its operating force of some 3500 men in 12 plants

HALF THE BATTLE of effective training of new men for power plant work is to get the right men in the first place. No amount or kind of training will make the square peg fit that very special situation that must be satisfied in the hiring of potential boiler and turbine operators and mechanics.

So good training really starts with the screening-for-hiring procedure, which should catch the cream of the available crop. The trick is to find out as much as possible about the applicant, and also to give him as thorough an exposure as possible to the nature of the job and its demands. Both sides must be covered.

At Commonwealth Edison Co this means thorough interviewing first by an employment interviewer, then by the superintendent of the plant where the applicant will be working. It also means — and this is of the utmost importance — complete checking of *all* school and job references given by the applicant.

Every applicant should (and at Commonwealth Edison must) give a complete account not only of his educational background but of how all of his time has been spent since his school days. Every one of these references is checked, looking sharply for tendencies to, 1, tardiness, 2, absenteeism, 3, inability to get along with others.

This checking process often turns into quite a chore, especially when the man has lived and worked in another part of the country. But Commonwealth rates it as absolutely indispensable and always carries it through to a final conclusion. However, this checking does not have to be completed before the man may start working on the job on a 90-day probationary basis (after having passed a physical examination by the company doctor). But by the end of 90 days, the checking at Commonwealth has usually been completed.

This emphasis on checking background and experience references perhaps leads to a concentration on younger men, and Commonwealth does find its best candidates among young men of high school education who have just finished their stint in the armed forces. However, the careful screening procedure is the same for all, no matter what age.

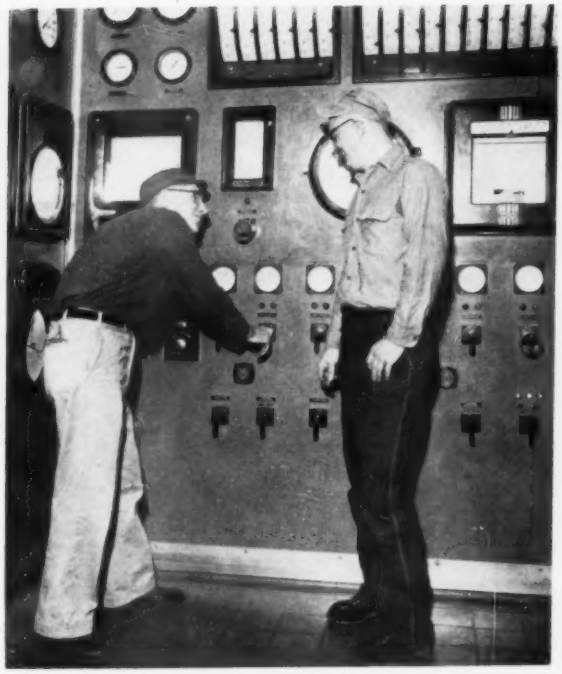
In talking with the applicant, it is of course essential to uncover as much personal history as possible. Questions should be slanted to the specific job. Some of the basic ones will bring out the following points and many others like them:

What are the man's family obligations? Can he get along on the rate of pay the job offers? Does he have debts and if so what is their nature? What kind of safety record does he have? Power plant work will require night shifts, also work on Sunday and holidays: does he have trouble sleeping during the day, or objections to working on Sunday? Does he have a fear of high places? Would he "freeze" when working on a boiler catwalk, for instance, or a stack?

If as a result of this kind of inquiry, the applicant passes the judgment of the industrial relations people, he is sent along to talk with the plant superintendent. The chief gives him a detailed description of the job, pulling no punches. Boiler-cleaning at best is hardly an inspiring task, and there's certainly no point in trying to hide the fact. But at the same time it is essential work and doing it provides an opportunity to learn the way around the plant which will lead to real operating responsibility in boiler room, turbine room, or switchboard. The applicant can be led to see this and also to catch enthusiasm for the advantages that attach to working for the company.

All this, in Commonwealth's pro-

2 At close of successful 90 days' probation, the new man confers with superintendent (Joseph Schrank of station No. 16) about area of work he prefers permanently



3 Coming up through various boiler room jobs, the trainee finally reaches the job of assistant boiler operator. Operator Frank Derreberry continues training of Bob Ehnert

cedure, is brought to a head in the applicant's interview with the station superintendent, at which time he will also be taken on a tour of the plant by an operating or maintenance supervisor. After this encounter, which includes watching closely for signs of real interest in the man toward the work generally, it is usually fairly easy to tell if you've got a comer.

Although mechanical ability does carry weight in qualifying a green man for work in a Commonwealth Edison station, the company does not use aptitude or psychological tests in its screening. The company feels that such testing is an extra step which, while perhaps useful to the over-all selection process, is neither infallible nor indispensable.

On The Job

Once on the job, the new man's training — both during his trial period and later — will be as effective as the foreman to whom he reports. The foreman is the key to good training results. At Commonwealth, as in most power plants, the new man's actual instruction in mechanical know-how comes on the shift from day to day, either from the foreman or from an older man in the same crew.

Unless the foreman feels secure in his job, he will not be likely to try to communicate full knowledge to the new man, and the training will not be adequate. Jealousies arising from training men too well can occur all along the supervision line, from plant superintendent down to first-line foreman; and Commonwealth points out that first-rate training can only be achieved when the truth has finally soaked into the organization that any supervisor's role is that of a catalyst in the total situation. As such, the foreman or supervisor must be willing to develop men who may turn out to be even better than he is. Fortunately, today the first-line foreman generally feels more secure than he did in earlier days.

It's up to the plant superintendent to set the tone and establish the philosophy of human relations that will nurture the best kind of training. At Commonwealth the effort is to key this philosophy to three concepts: dignity, respect, persuasion.

The training objective — efficient operation and maintenance of complex machinery — is to be won by investing the trainee with a sense of his innate dignity and importance as a human being. This view is constantly impressed upon foremen in Commonwealth power plants. It begins to make itself felt by the trainee from the very first day of his 90-day trial period.

On this first day he has an orientation conference with the plant superintendent and learns about routines of the plant. He learns also about the courses in power plant fundamentals which are given by the company's education and training division. If he survives his 90-day probation and becomes a permanent employee, these courses will be open to him, and he is urged to plan to take advantage of them. (It is significant to note that about 75 per cent of Commonwealth's new men do take these courses.)

The foreman who takes over the beginner tries to keep as close as possible to him during the 90-day trial. First lesson is on working safely — teaching the man never to do anything until he has figured out how to do it safely. Details of cleaning a boiler inside and out will be explained; the trainee will watch the performance of the mechanical soot blowers, take a turn at hand-lancing, and when a boiler is down, he will help to wash it.

Evaluating the new employee is the responsibility of each station superintendent and his management people. In doing this, some will use a form and others will use a less formal approach. In any case, a written record should be kept of a man's accumulating experience in the plant. The Boiler Room Training Record form shown in Fig. 5 is one sample of Commonwealth's way of doing this. This form is divided into the four grades of jobs through which a man progresses in his career in the boiler room. Such a record is indispensable to conferences involving the work record.

There's nothing secret about the job performance reports a foreman makes to the superintendent. The men can see the reports at any time, and the point is brought home that the man himself makes the record, not the foreman.

In judging trainees, foremen at Commonwealth tend to stress these four points: work output, cleanliness, seriousness with which safety rules are followed, absenteeism. If the foreman is convinced that the new man will not work out, he makes this plain in his reports to the superintendent before the end of the 90-day probationary period.

By the close of the 90-day trial, the new man should know what job in the plant he would prefer on a permanent basis — whether it be in boiler

4 Off-the-job courses, given by the company, are popular with trainees. Here's one in boiler and turbine controls

BOILER ROOM TRAINING RECORD NAME

(Dates of Training)	HELPER	AUXILIARY OPR.		ASST. BLR. OPR.			BOILER OPERATOR				
	1–2	4	5	Reg.	17		1–2	3–4	15–16	17	7

5 Use of a form such as this gives a quick picture of a man's accumulating experience in the power plant. Such a record is indispensable to work conferences. Superintendent talks with trainee each time foreman reports on job performance

room, turbine room, or in maintenance.

Job Choice

At this point some Commonwealth superintendents ask the man to write a letter stating his job preference, with the reasons for it. This letter is accompanied by a report from the trainee's supervisor and forms the basis for the conference between trainee and superintendent which marks the new man's acceptance as a permanent member of the crew.

As closely as conditions will permit, the superintendent will try to match the man to the job of his preference, if that preference seems to be realistic. At the end of his first 90 days in the plant the new man is thus either given assurance that he will eventually be considered for the job he wants, or is told that in the superintendent's judgment, another area of work seems better suited to him.

Established in the plant on a permanent basis, the new man's training continues as before, with daily on-the-job instruction from foreman and co-workers, plus growing responsibility of his own. Night shifts and summer operating schedules make it possible to ready him for higher work by filling in on next-higher jobs temporarily.

At Commonwealth, it may be two years before the new man who wants to be a boiler operator, for example, can advance from stationman to operator of a stoker boiler. It is no mean task of training to keep up his interest during the months while this opportunity is slowly ripening. Summer vacation schedules and the need to fill in for operators afford a way to cope with this problem.

As a would-be boiler operator, the trainee at Commonwealth finds these aids available and helpful: a one-line piping diagram of the whole plant; a copy of the company-written instruction manual that applies to the unit on which he is working; a station instruction book — what to do about fires, accidents, purging boiler gas headers with CO_2, feedwater header tie valves, and so on. Some foremen find it helpful also to supply a mimeographed set of questions-and-answers relating to the construction and operation of the unit on which the man will mostly be working.

If a trainee elects to go into maintenance, in its training approach Commonwealth again recognizes that what counts most is experience with the equipment. Outside-the-plant training doesn't help much; a man actually working on the plant machinery can learn more in a month than in a year in a trade school. At one Commonwealth station, for example, machinery in operation ranges in age from 45 years to brand new, and every unit is different. A maintenance man must become familiar with all of it.

To bring this about, when work is slack or pressure is not great to get the job done in a hurry, a second-grade man may be assigned to first-grade work, under the guidance of the first-grade man. The key to success with this procedure lies in the honesty and fair-dealing spirit of the master mechanic who assigns the work, and in the men's respect for this.

Training in the maintenance area is difficult, because in a power plant the maintenance man must be a precision man one day, a mechanic the next. He must not only be a machineman but a diagnostician who can analyze the trouble as well as fix it. Thus intimate experience with the equipment is really the only thing that counts, and this objective must motivate all training concepts for this area of work.

Foreman Do's and Don'ts

Summing up, the most crucial link in the training of new men for power plant work is the foreman. He must be keenly aware of the responsibility and, in spite of his load of many other duties, find the necessary time to spend in personal contact with the new men who have been assigned to his crew.

Here are a few basic do's and don'ts which one of Commonwealth Edison's crack foremen passes along from his own experience in working with new men:

1. Take time to talk casually and informally with the new man, and get acquainted.

2. Start working at once with him on safety. Show him how to do it safely.

3. Try to make him see the advantage of getting more education, either in company-given courses or outside. Warn him against getting stuck on the job through lack of initiative.

4. Never tell a man he's doing wrong, in front of others; and when you do talk to him, try to get at the root of the difficulty.

5. Try to hold a meeting of your whole crew once every three weeks, to talk over common problems.

6. Drive home the importance of the work and the advantages of working for the company.

7. Impress on the man who may think he's beating the company out of time, that he's really only cheating his co-workers.

8. Give credit where credit is due for good work done or helpful ideas contributed. THE END

OUR READERS ASKED FOR IT

This is the first of several articles on training men for power plant work. Coming soon:

- Over-all Training for an Industrial Power Plant
- How to Train Power Plant Supervisors
- How to Train Better for Maintenance
- Training on the Job for Graduate Engineers
- Training Operators for Atomic Power Plants

Supporting these feature articles will be the serial publication in our Handbook section, beginning in May, of *Introduction to Steam Power*—a basic training text for the power plant chief to use in giving his crew the technical why's of their work.

FOLLOW THIS READERS' CHOICE FEATURE in POWER ENGINEERING

Common Sense as Applied to Electrical Distribution

Performance, reliability, operating cost, initial investment, and uniformity are important in building new systems or remodeling old. Author discusses frankly application of sound, pertinent thinking

By JOSEPH SCHNEIDER *

WITH THE ADVENT of rapid industrial growth, the power engineer is confronted repeatedly with the problems of expanding electrical facilities. While original equipment manufacturers specify all process motors and motor controls, the power engineer must specify the wiring and wiring protective devices. In specifying the wiring he must remember the distribution system requires as much common sense in its design as it does engineering skill.

Although the distribution system is closely integrated with the manufacturing process, electric power is the slave of the process, not the master. The distribution system should be simple for maintenance reasons, and obviously economical. Prudent use of good materials provides greater economy and reliability than indiscriminate use of cheap materials; however, the most expensive materials are not necessarily required to provide the utmost in reliability and performance.

Materials should be loaded to their economical limits. Future requirements should be provided for with empty space, where possible, rather than with idle or partially-loaded equipment. Unless this approach is followed, much of the equipment installed may go unused due to an unanticipated change in plant operation. The less the investment in unused or lightly-loaded electrical equipment, the more the investment available for plant expansion.

Chief Factors

Distribution problems in new and existing plants differ. In new plants the engineer has complete freedom in the selection of utilization voltages, equipment and distribution schemes. In operating plants, maintenance problems and the necessity of reusing existing equipment restrict these selections. In both cases performance, reliability, operating cost, initial investment and uniformity are important.

Performance and reliability can be obtained in any well-designed and properly-installed system. System losses are important, normally, only where long hours use of demand are experienced.

Investment cost is affected by switchboards (a function of short circuit capacity as well as load); light and power panelboards; safety switches; motor controls (including control transformers and disconnects); lighting, power, and booster transformers; special switches and ballasts; wiring methods, such as cables and raceways; and grounding.

Voltage Selection

Uniformity, while automatically obtained in new plants, may be a problem in designing large additions to overgrown existing plants. For example, in such cases a new distribution system with different voltage characteristics frequently becomes financially attractive. The financial advantages should be evaluated against intangible operating problems such as the willingness of maintenance personnel to accept the change.

Several utilization voltages are in common use for light and power. For lighting, 115/230, single-phase, 3-wire; 120/208, three-phase, 4-wire; and 277/480, three-phase, 4-wire are used. For power 208, three-phase, 3-wire; 230, three-phase, 3-wire; and 480, three-phase, 3-wire are used.

Combined light and power systems, namely 120/208 or 277/480 volts, three-phase, 4-wire, offer advantages in that basically only one major distribution system is required.

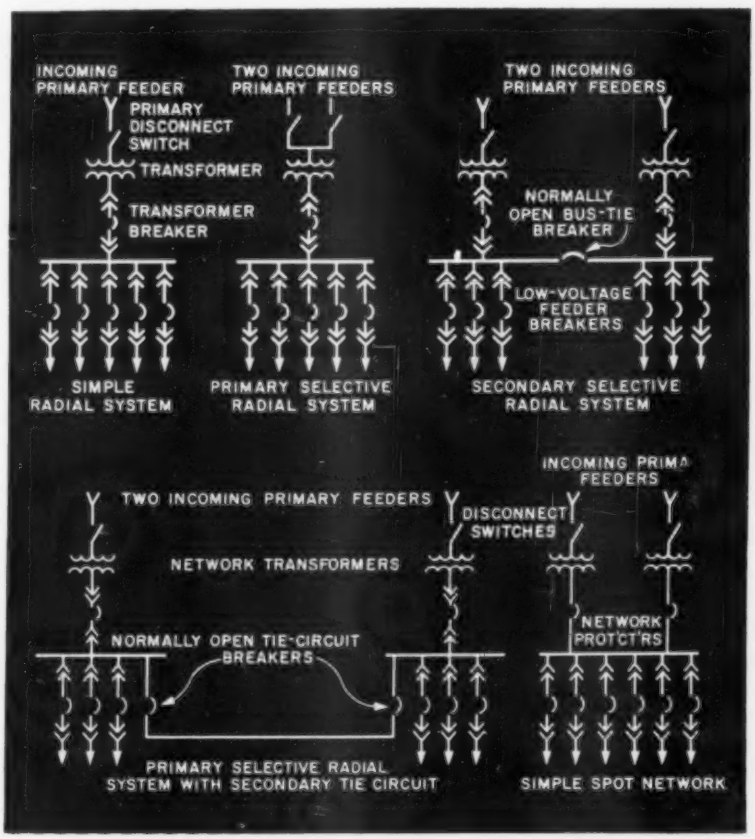


Fig. 1. Comparison of basic types of interior electrical distribution systems. Selection of the proper system for a given installation depends on many factors

*Associate, Linenthal and Becker, Consulting Engineers, Boston, Mass.

However, the 277/480-v system requires transformers to obtain power for 120-v convenience outlets and regular base incandescent lamps.

For use on any of these systems, three-phase motors of the same hp have the same frame size, and are generally interchangeable; motor starters of the same NEMA size vary only in the rating of holding coils (and control transformers where desired), and are generally interchangeable; power circuit breakers of the same type and rating are interchangeable; cables and raceways are of the same voltage class and are generally interchangeable; lighting circuit breakers and safety switches are not necessarily interchangeable unless rated for the highest voltage; and fluorescent and incandescent lamps of the same type are interchangeable.

Few, if any, special parts are required for maintenance with any of the systems. Economically, a high-voltage combined light and power system operating at 277/480 v is not necessarily less expensive than a low-voltage combined light and power system operating at 120/208 v; unless the total load is large, the incandescent lighting load is small and the motor load consists of enough large motors to save on overall motor control and branch wiring costs. In border-line cases lower-voltage systems frequently find favor among operating personnel.

Selecting Basic Scheme

A very successful approach when designing and specifying an electrical distribution system is starting with nothing and adding to accommodate the loads, rather than starting with everything and subtracting to accommodate the budget. Much has been written in the literature about basic types of interior distribution systems such as, simple radial, primary selective radial, secondary selective radial, and simple spot networks. Each system, as is obvious from inspection of Fig. 1, has successively greater flexibility and reliability for greater initial cost.

When selecting a basic scheme, the entire plant, both mechanical and electrical, should be considered as an entity. Electricity has no moving parts and is more efficient, reliable, and convenient than any other known means of power. A single-line electrical system is more reliable than a single-line mechanical system. A double-ended electrical system supplying a single-ended mechanical system does not necessarily make sense!

There is no guarantee that the cause of an outage on a simple radial system would not cause an outage on a more elaborate system. Overloads can be anticipated since they never occur suddenly, and low-voltage cable shorts on properly-installed systems are extremely rare. Short circuit protection on all equipment should be coördinated to isolate the faulted device without causing interruption to sound equipment. In the event of an unforeseeable outage, temporary repairs can be effected rapidly with a hack-saw, and some "shoe-string" wiring.

Choice of Breakers

Main distribution switchboard and/or power panelboards should fulfill the requirements of adequate load capacity, short circuit capacity, and operating convenience. They can be of switch-and-fuse design, molded-case circuit-breaker design or low-voltage air-circuit-breaker design, in the order of greater expense.

Molded-case breakers and air circuit breakers have the added advantages that they can be reset readily

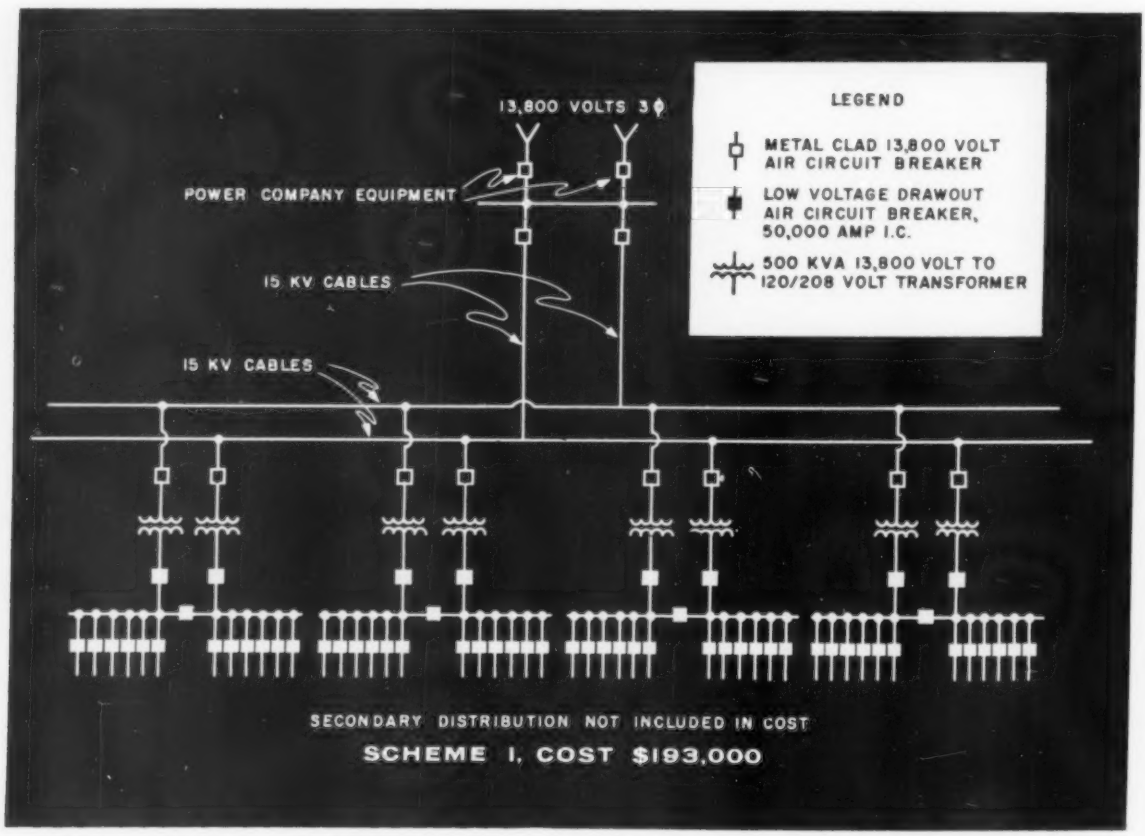

13,800 VOLTS 3φ
POWER COMPANY EQUIPMENT
15 KV CABLES
15 KV CABLES
LEGEND
METAL CLAD 13,800 VOLT AIR CIRCUIT BREAKER
LOW VOLTAGE DRAWOUT AIR CIRCUIT BREAKER, 50,000 AMP I.C.
500 KVA 13,800 VOLT TO 120/208 VOLT TRANSFORMER
SECONDARY DISTRIBUTION NOT INCLUDED IN COST
SCHEME I, COST $193,000

Fig. 2. **Before.** Client of the author had decided on this elaborate distribution system at the time that consultation began. Fortunately the engineering had not reached the bidding stage, and it was possible to effect savings of over two-thirds

and that all three poles open on a disturbance thus avoiding one cause of single-phase operation.

Actual choice of short circuit protection depends on the particular requirements of the installation. The author tends to avoid low-voltage air circuit breakers, whenever either of the other two will suffice, provided that repeated switching operations are not required.

It is frequently possible to avoid installing main secondary breakers entirely. In so doing an inexpensive all-circuit-breaker design using molded-case breakers can be achieved within Underwriter's ratings on single-ended substations up to 1000-kva capacity at 480 v, and 500-kva capacity at 220 or 208 v. Using NEMA ratings these sizes can be increased.

Increased field labor costs have made factory-assembled equipment increasingly attractive. On large installations, for example, it is sometimes possible to install factory-assembled motor-control centers for less money than field-assembled installations, providing the design can be coördinated with, and meet the requirements of, the original-equipment manufacturers.

Many general wiring systems are available. It is good practice to use the least-expensive system for each particular problem. The National Electrical Code clearly defines the limitations of less-expensive methods and materials such as thin-wall tubing, wireways, open wiring, and various cable insulations.

Other Factors

Other limitations may be imposed by the power engineer. Such restrictions, however, should be imposed only on a basis of environment and equipment exposure. The National Electrical Code is written with safety and fire hazard well in mind. Certain wiring methods such as neoprene-jacketed cables laid in open trays have not as yet received the recognition of the National Electrical Code and can be employed only when the National Electrical Code does not legally govern the work.

Branch circuits should not be restricted to 15 or 20 amp when the Code permits 30 to 50 amp circuits. When in trouble with voltage drop consider booster transformers rather than oversized copper. Incorporate extended buses and feeder taps in the design. All of these methods can result in lower initial cost with no sacrifice in the reliability or performance.

As an example of what can be accomplished by coördinating the electrical requirements of the plant refer to Figs. 2 and 3, which present the before and after of a large industrial light manufacturing plant containing 350,000 sq ft on a single level. This is an actual case history where the owner was prepared to proceed with Scheme 1 as his minimum requirements, and after reviewing his plans and conferring with the author actually installed Scheme 2. The plant has been successfully operating for three years.

Size Irrelevant

The approach is not limited to large establishments. We recently were able to reduce the cost of wiring (originally $35,000 to $40,000 each) in large suburban type grocery supermarkets 20 to 25 per cent without changing the number of lighting fixtures, motors or devices, and actually incorporated better materials in the design. An even smaller example is a completely automatic car wash. Ours went for $12,000 and an identical installation not 50 miles away cost $18,000. It's easy — all you have to do is think! THE END

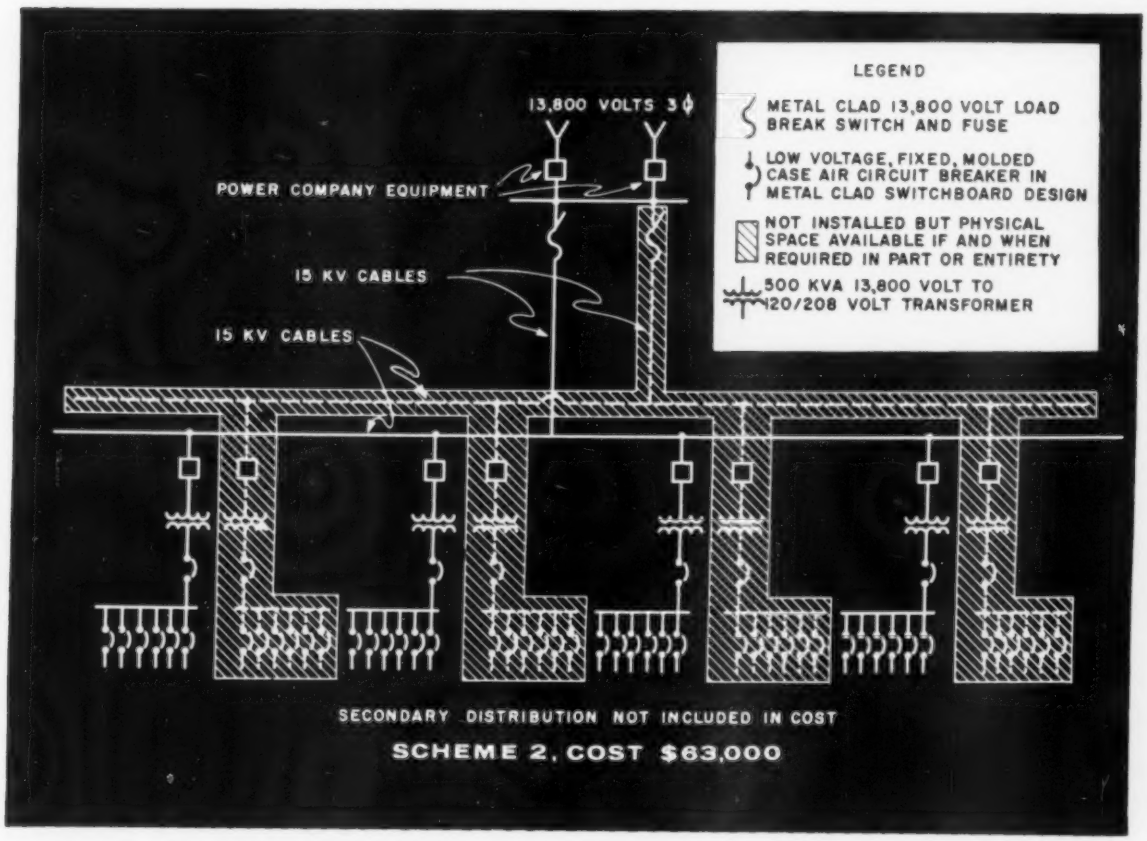

LEGEND
METAL CLAD 13,800 VOLT LOAD BREAK SWITCH AND FUSE
LOW VOLTAGE, FIXED, MOLDED CASE AIR CIRCUIT BREAKER IN METAL CLAD SWITCHBOARD DESIGN
NOT INSTALLED BUT PHYSICAL SPACE AVAILABLE IF AND WHEN REQUIRED IN PART OR ENTIRETY
500 KVA 13,800 VOLT TO 120/208 VOLT TRANSFORMER
13,800 VOLTS 3 ϕ
POWER COMPANY EQUIPMENT
15 KV CABLES
15 KV CABLES
SECONDARY DISTRIBUTION NOT INCLUDED IN COST
SCHEME 2, COST $63,000

Fig. 3. **After.** This is the system that was actually installed. Interest on savings will make any future equipment cheaper. All of the equipment which would not immediately be used at near capacity was eliminated but space was provided for it

How About a Central Fuel Committee For Edison Electric Institute?

The author has spent many years in the business of buying, transporting, analyzing and burning of coal—in the utility field. He feels very strongly that such a committee should be established, and produces some thought-provoking arguments to prove his point

By **FRED M. REITER** *

THIS AUTHOR is in favor of the formation of a Fuel Committee within the Edison Electric Institute, apart from the Purchasing or Prime Movers Committees. Fuels comprise an increasing percentage of the operating outlay for the generation and distribution of electricity. The annual purchase of fuel far exceeds that of all other non-fuel items combined. Prorated over its years of life, the investment for generating plants could be added to the annual cost of non-fuel supplies. These proportions will undoubtedly continue on through the atomic-fuel future.

With such an outlook into a complex future, in the problems surrounding its biggest single item of purchase, top policy coördination of fuel, within the fabric of the EEI, will be invaluable.

This committee would be selected from a group of fuel engineers, fuel buyers, traffic managers, coal inspectors and boiler engineers; all having to do with the procurement, movement and utilization of fuels. It would be on the same level with, but separate from, other committees which have heretofore handled fuels as minor subjects on their agendas.

This committee would make its recommendations to the Institute and serve as a center of discussion among the member companies; advising them of their findings on the problems common to all. It would guide their fuel men, for the good of the three interdependent industries concerned with fuel: production, transportation, and utilization.

(*Editor's note:* The author has presented some interesting ideas in this article. We will welcome all comments from readers; pro or con.)

Why Such a Committee?

Much has been spoken and written on the expanding "take" from the daily coal supply of this country, by the privately-owned utilities. The word "take" has a multiple connotation, containing at least six significant factors:

1. Electric generation curves continue in the same upward trend — doubling every decade. Their appetite for coal has grown in the same geometric progression. Table I shows that from 1937, the kwh production of 74.9 billion was doubled in 1943, and again in 1952 — to 288 billion kwh; four times the consumption of 1937 — in only 15 years.

Table II projects this power generation from 1955 to 1980, into the atomic era. The doubling each decade continues to 1975, when atomic energy will slow down the acceleration of the coal consumption curve.

Coal consumption related to its exclusive use for power production stood at 32.8 million tons in 1932; 67.5 million tons in 1942; and 107 million tons in 1952. This is not quite quadrupled, because of the decrease in tonnage of coal to produce 1 million kwh, with the improvement in equipment.

The 20-year increase in consumption of fossil fuels (coal, oil and gas) is listed by years, from 1939 to 1959 in Table III. Here again the doubling every decade is shown. The use of oil and gas had an ever-greater rate of acceleration; six times for oil, and almost eight times for gas — in two decades. The rate of expansion for oil and gas has slowed down. For the half decade, 1954 to 1959, coal's consumption will be normally increased (52 per cent); but oil and gas diminish to 47 per cent and 30 per cent respectively. But the general average for all fossil fuels (46 per cent) is still at the approximate doubling rate of acceleration.

One can foresee the tremendous incremental growth of this phase of the take of the nation's production of fuels, by the utilities in power production.

2. Electric power generation, and its phenomenal increase within its own industry, contrasted with the diminishing purchase of coal by other coal consuming members of the coal market, enhances the importance of the electric utility coal procurement.

Table IV lists the consumption of bituminous coal, by industries, for the years of 1943 to 1953, with an estimate for the percentages of coal consumed by these industry groups in 1975.

Table V projects Keystone's predictions on the expected coal procurement programs of these industrial segments, and for export from 1955 to 1970. From the viewpoint of the take for electric power generation, this giant has grown from 12 per cent of the total consumed from U. S. coal production in 1943, to 35 per cent in 1975. The former giants of 1943: railroads, retail sales, industrial plants, etc, have dropped greatly in stature. A new Goliath is appearing on the horizon — (chemicals and synthetic oils) — but it has plenty of time to wield its influence on the nation's coal; probably until 1970.

Up to that time the electric utilities are the predominant factor in the coal industry; its backbone, in many ways.

3. The electric coal load is constant. In fact, with its air conditioning advances, peak demands for electricity (and coal that produces it) have come in the summer in large segments of the country. This is perfect for fuels whose greatest demands for space-heating of living quarters comes in the winter; leaving valleys in summer sales and production. These summer doldrums would hurt not only the mining and sale of coal, but all allied industries involved in the movement of coal from mines to market.

Coal is put on special sale in the summertime, in order to move it. This keeps miners at work, mines from closing, equipment from gathering dust, and *overhead* from being too burdensome. Shipments of certain sizes of coal, via lake movement, helps considerably in summer sales. Transportation costs remain constant; therefore, it is best to build up stocks in the summer.

4. Electric utilities carry large stocks of coal — up to three or four months supply. Many coal-using companies keep their coal piles static; untouchable, — a monument to reserve and readiness to serve. Mobile stockpiles would make excellent cushions; — accordion-like air chambers, or fly-wheels — to keep the market supply and production more stabilized, and would accommodate some of the variations in demand that the coal industry faces.

The tonnage could be built up at "bargain summer rates," and decreased in winter, when demands are high. Then transportation is at peak levels, and freezing weather makes the coal unloading from cars more difficult; and intangible taxes make for higher costs.

5. Range of coals usable in most large utility boilers is wider than for the stokers and furnaces of smaller boilers. The latter may require high-fusion ash coals, limited ranges of

*Fuel Engineer, Dayton, Ohio

This series of tables is shown to emphasize the need for a Fuel Committee in EEI. These figures prove that utilities are the largest coal user, today and in coming years.

Table I

Annual Electric Power Production

Year	Generation Billion kwh
1937	74.9
1938	69.5
1939	84.1
1940	94.5
1942	122.1
1944	154.2
1946	144.8
1948	200.2
1950	233.2
1952	294.1
1953	337.0

Table II

Predictions of Generating Capacity and Coal Use
1955 to 1980

Year	Millions of kw				Millions of tons
	Nuclear	Hydro	Steam	Total	Coal Use
1955	0.0	26	90	116	140
1956	0.0	27	98	125	155
1957	0.01	28	103	131	165
1958	0.14	34	108	142	174
1959	0.14	38	116	154	180
1960	0.94	40	127	167	210
1965	5.00	50	177	232	282
1970	10.00	60	226	320	393
1975	40.00	70	285	395	430
1980	120.00	80	314	514	470

Table III

Fossil Fuels Consumption by Electric Utilities
(With Keystone's Predictions to 1959)
(Millions of tons of coal—or coal equivalent)

Year	Coal	Oil	Gas	Grand Total
1939	45	4	8	58
1940	51	4	8	63
1941	63	5	8	76
1942	66	4	9	79
1943	77	5	12	93
1944	80	5	14	99
1945	74	5	13	92
1946	72	9	12	93
1947	89	11	15	116
1948	100	11	19	130
1949	84	17	23	125
1950	92	19	25	138
1951	105	16	33	155
1952	107	17	37	161
1953	115	20	42	178
1954	118	17	46	181
1955	140	18	45	203
1956	155	18	50	223
1957	165	20	51	236
1958	174	22	58	254
1959	180	25	60	265
% expansion '54–'59	52%	47%	30%	46%

Source: 1939–1954—Federal Power Commission
1955–1959: Predictions based on estimates received from major utilities.
(Keystone Coal Buyers Manual)

Table IV (Bituminous Coal only)

Bituminous Markets by Industries 1943 to 1952
Also Projected Estimate for 1975

Industry	1943 Millions net tons	1943 Per cent of all	1952 Millions net tons	1952 Per cent of all	1975 Projection— Per cent of all
Electricity	74.0	12.4	103.3	24.6	35
(1) Iron and steel	96.5	16.2	92.4	22.0	20
Non-steel coke	14.3	2.4	9.0	2.2	
Gas, producer, etc.	7.7	1.3	5.0	1.2	
Cement	5.8	1.0	8.1	1.9	26.5
Oil refineries	1.8	0.3	0.8	0.2	
Other manufacturing	127.5	21.5	68.0	16.2	
Railroads	135.7	22.9	39.0	9.3	1.5
(3) Foreign, bunker	1.6	0.3	0.7	0.2	5
(2) Retail, others	128.7	21.7	93.7	22.3	
Synthetic oils	—	—	—	—	12
Totals	593.7	100%	419.9	100%	100%

(1) Iron and steel includes coal for metallurgical coke.
(2) Retail and others includes all coal not assigned to other groups.
(3) Bunker coal is for ships engaged in foreign trade.
Sources: Bureau of Census, Federal Reserve Board, Federal Power Commission, American Gas Association, American Iron and Steel Institute, Bureau of Mines, Interstate Commerce Commission.
(Table taken from Bituminous Coal Annual, 1952, National Coal Association, Washington 5, D. C.)

Table V

Keystone's Predictions of Coal Consumption in the U.S.A., and Exported Coal, 1955 to 1970. (Thousands of tons)

	1955	1956	1957	1958	1959	1960	1965	1970
(1) Utility	140	155	165	174	180	210	282	383
(2) Coke (Steel & Chemical)	144	119	124	129	133	140	175	220
(3) Other Industrial	95	100	102	104	109	140	180	240
Railroad	15	14	12	10	10	12	20	30
Retail	57	58	59	60	60	58	50	40
Export								
Canada	18	15	12	12	12	10	13	15
Overseas	30	35	35	35	35	30	25	20
Totals	469	496	509	524	539	600	745	968
(4) Gas & Oil Synthesis	—	—	—	—	—	—	70	350
New totals	—	—	—	—	—	—	815	1,308

(1) Including Air Conditioning and Taconite
(2) Including Low Temperature Carbonization
(3) Including Aluminum
(4) Highly speculative
Source: Keystone Coal Buyers Manual

Table VI

Expected Coal Use by Electric Utilities
(Thousands of tons per year)

Year	TVA and AEC	Utilities using More than 100,000 tons annually	Utilities using Less than 100,000 tons annually	Total
1955	20,635	62,085	1,086	83,801
1956	27,650	64,988	1,186	93,824
1957	29,140	69,122	1,271	99,533
1958	30,340	72,949	1,407	104,696
1959	32,240	75,186	1,557	108,983

(Source: Coal Mine Directory and Keystone Coal Buyers Manual.

screened sizes, fast burning types, or coals that will not smoke during firing. The larger equipment has a wider tolerance for ash and moisture content.

In order to equate price per ton, and Btu per lb of coal, into equivalent cost value, adjustment formulas can be applied to wide varieties of coal, in order to arrive at coal values fair to all producers. There are so many different formulas used today, that coal salesmen must get confused in their daily contacts and bidding. Sulphur and grindability have vague values, in terms of cost, to the boiler plant — in corrosion and wear on equipment.

Many buyers of coal may not fully comprehend the cost of handling, conveying, grinding and firing of useless ingredients in coal. These elements pass through burners, past cooling tubes, through air heaters, dust collectors or precipitators; then up the stacks and into the atmosphere — which may be over populous areas. Their fuel engineers do understand. These men can convert chemical analyses into cents-per-ton of coal. Perhaps a general purchasing agent does not have the background, nor the power plant experience required for the job.

6. Transportation is a big factor in the price of the coal, f.o.b. boiler plant. Transportation has so many facets today; ***continued on page 128***

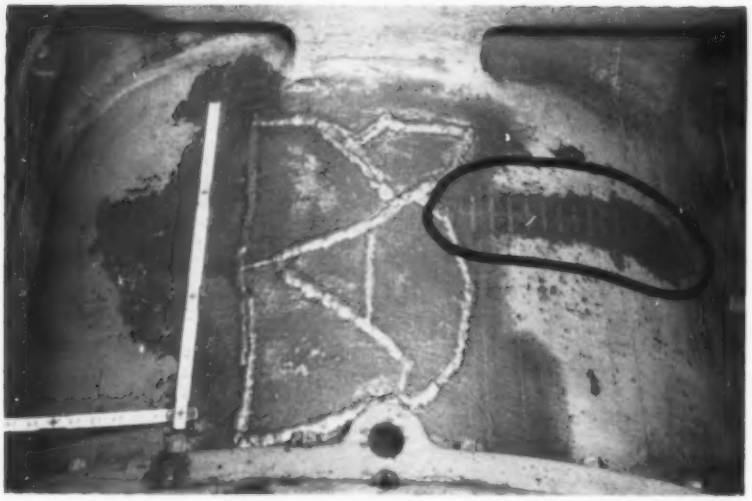


Fig. 1. This cast iron bearing housing has been repaired by metal locking (or stitching), then sealing the surface to oil-tightness using a low-temp brazing

A sequel to Mr. McParlan's very popular article on Non-Destructive Testing in the March, 1957, issue of POWER ENGINEERING, this series of case histories proves that permanent repairs, on an expediency basis, are a vital function of good maintenance

Repairs Cut Down-Time at Con Ed

By JOSEPH L. McPARLAN*

ALTHOUGH electric generating station maintenance and general industrial maintenance have much in common, there exist marked differences between the two which, in the case of generating station maintenance, pose special problems. The purpose of this article is to show how some of these problems have been solved in Con Edison installations.

Large physical size and the high cost of electric generating station equipment preclude the carrying of extensive replacement-part inventories either by the operating utility company or by the manufacturer. Replacements must be made to order. Thus, even for relatively minor parts delivery time may run into several months.

Further complications often arise from the necessity for using special materials to withstand today's elevated operating temperatures. Finally, the high use factor imposed on large and efficient generating units makes protracted outages intolerable.

Because outright replacement in kind thus frequently is out of the question, the problem then is to make major repairs in place or to accomplish necessary rehabilitation without extensive dismantling of the apparatus.

Some of the problems of this type which have confronted us, and our solutions to them, are described below.

Metal Locking: — The cast-iron bearing cover of a turbine generator, shown in Fig. 1, was damaged by the failure of a jaw of the turbine generator main coupling. Fortunately a spare coupling was available and was installed on the machine. Time did not permit fabricating a new cover so repairs were made by a combination of locking the fractured metal me-

*Superintendent, Mechanical Construction Bureau, Consolidated Edison Company of New York, Inc

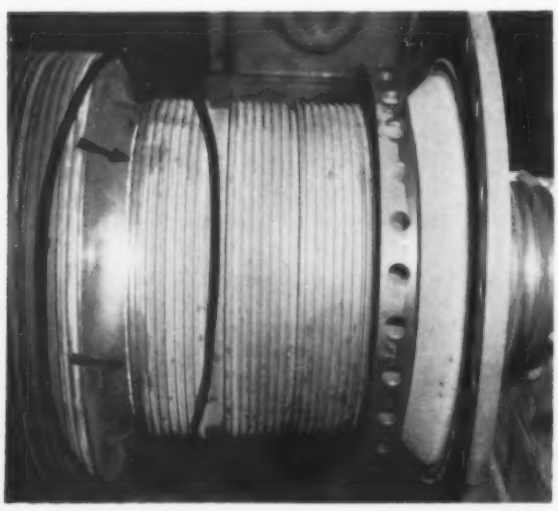


Fig. 2. Circumferential crack in h-p spindle was discovered during magnetic-particle inspection for an unrelated cause

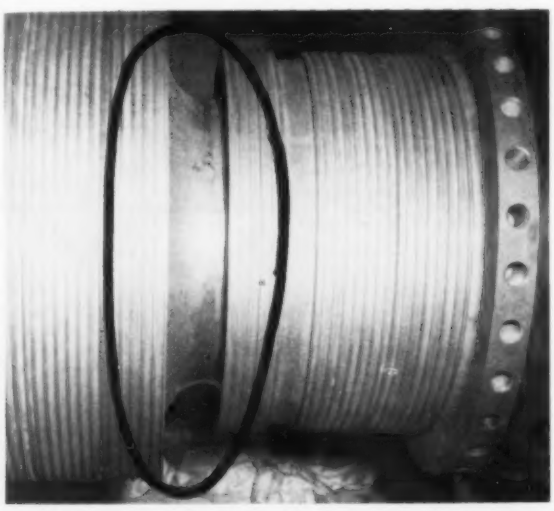


Fig. 3. Depth of crack could not be determined, and was machined out, with proper radii, to final depth of about 2 in.

chanically across the breaks, and then sealing over the surface with low temperature brazing, making the repaired area oil-tight.

Mechanical locking or stitching of cracked cast metal parts has the definite advantage that some breaks may be repaired in place, without costly dismantling. In addition, distortion of machined faces due to the general preheating required in a conventional brazing repair is avoided.

Cracked Turbine Spindle: — The existence of sources of serious trouble in unexpected places is sometimes disclosed by merely routine inspection. Figure 2 shows the high-pressure spindle of a 137-mw cross-compound turbine generator. This unit came out for investigation of abnormal stage pressures and high vibration. The source of the trouble, a broken steam guide, was located readily between the first and second stages.

Because the steam guide had damaged the first-stage buckets and second-stage nozzles, the spindle was examined throughout by the magnetic particle method. This led to the unexpected discovery of a 360 deg circumferential crack in the shaft fillet of the outer labyrinth packing lands at the high-pressure end of the spindle as indicated in Fig. 2. Further inspection by ultrasonic methods was made in an effort to determine the depth of the crack but results were inconclusive.

Only recourse was to machine out the shaft metal in the area until the crack disappeared. This cycle of cut and test continued until the defect bottomed at a depth of about $1\frac{3}{4}$ in. Generous radii were provided in the bottom and flanks of the groove to minimize stress concentrations. This further increased the depth of the groove to 2 in. and, it is believed, removed all vestiges of the crack.

Capability of the shaft with its diameter reduced to $13\frac{1}{2}$ in. was investigated by the designers and found satisfactory for service. Fig. 3 shows the reduced section. One high and two low packing lands were sacrificed in this process without any observable impairment of sealing effectiveness after the machine was returned to service.

Extension Shaft Failure: — Shaft shown in Fig. 4 is an extension or stub shaft pressed into the forward end of the main spindle of a 65-mw topping steam turbine. As originally designed, the extension beyond the No. 1 bearing was integral with the main shaft. However, the threaded section of the shaft under the thrust-collar retaining nut developed cracks and it was necessary to resort to the fitted extension shaft arrangement, shown in Fig. 5.

Overhung extension carries the thrust, overspeed trip, eccentricity collar and governor drive. The break in the shaft was discovered during an inspection conducted to determine the cause of excessive spindle eccentricity and high temperature readings at the squealer ring, after the unit had tripped off due to the former. Only the light-colored portion of the shaft in Fig. 4 was still intact, preventing a major disaster, including the loss of the main thrust bearing and all the consequent damage which could result.

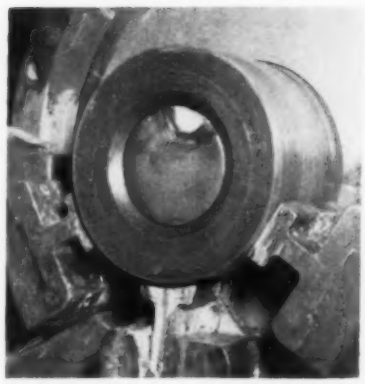


Fig. 4. Near-disaster illustrated here. Only light portion held turbine thrust

All dimensions in Fig. 5 are nominal. The stub shaft shoulders up against the end of the main spindle and is held by two heavy fits in the bore. Two $1\frac{5}{16}$-in. pins dowel the assembly. As shown, the break occurred at the extreme end of the outer fit. It is believed that high contact stress at the edge of the 45-deg chamfer plus flexural stresses due to unavoidable vibration contributed largely toward the failure.

In the new stub the 4-in. diam at the inner fit was retained but the diameter at the outer fit was increased to 5 in. Instead of terminating abruptly at the 45-deg chamfer, the outer fit was eased off as shown to provide a gradual transition forward from the highly stressed area. These alterations were aimed at lowering the stress concentration in the critical zone.

In addition to these measures, it was decided to weld the stub to the end of the spindle at the shoulder. A V-groove was provided and a consumable backing ring tacked in place. The new stub was then pressed into place ready for welding. Argon was introduced into the annulus below the insert via a $\frac{1}{16}$-in. copper tube which penetrated the backing ring.

Material to be welded was identified as ASTM Spec. A-293, Class 6 for turbine rotors. The welding procedure specified preheat to 450 F, then fuse the weld insert completely with a shielded tungsten arc torch. The work was completed by conventional welding using Croloy 1-A filler rod. Stringer beads only were laid in. The assembly was immediately brought to 1200 F by induction heating, held there for four hours, then cooled to room temperature at the rate of 35 F per hr.

The shaft was then finish-machined and the turbine reassembled. This work was completed in September, 1956 and the shaft has been in continuous service since then with no evidence of trouble.

Sprayed Metal: — In addition to what is considered normal wear, machinery which must operate continuously may be unavoidably subjected to extraordinary deterioration from erosion, corrosion and cavitation. That section of steam turbine shafts adjacent to water gland runners is especially susceptible to these attacks.

Figure 7 shows deterioration, which, if permitted to progress far enough, could render the shaft unusable. In its present condition the inboard labyrinth seal has ceased to function properly because of excessive radial strip clearances. The damaged portion of the shaft was turned down to solid metal and then restored by spraying with monel.

Monel was chosen because of its corrosion-resistant properties and its effectiveness in retarding impairment due to erosion. Because of the uncertainty due to residual stresses and to the somewhat indefinite mechanical

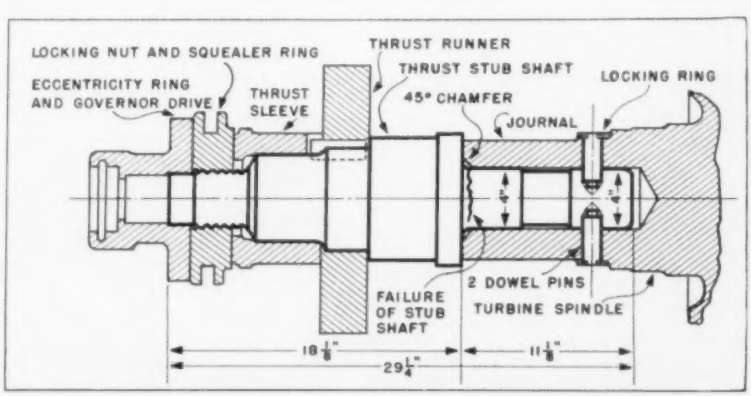


Fig. 5. Cross-section of the press-fitted shaft extension which failed. The high stresses at the 45-deg chamfer caused the cracking. Repair is described in text

Fig. 6. (Left) Typical erosion in last-stage buckets of low-pressure spindle. Either stellite welding or use of silver-brazed stellite strips is good repair. Fig. 7. Corrosion has rendered this labyrinth seal useless. Metal spray was repair

properties of the sprayed-on metal, it was considered advisable to hold the thickness of the applied layer to about 0.040 in. or 0.050 in.

Machined grooves are used to provide a mechanical anchorage to assist adhesion of the built-up metal to the shaft surface. Shallow, fine V-threads machined in the shaft may also be used for the same purpose.

Metal Plating: — In the case of small mechanical-drive turbines or pumps whose shafts are exposed to damage from corrosion, a protective layer of metal plating may be used to advantage. If the surface has been scored, objectionably deep grooves must, of course, be machined out to true up the shaft. Plating up to a thickness of 0.030 in. may then be applied by any commercial plating shop equipped to handle this class of work. For corrosion and erosion resistance, chromium plating has proved very effective.

Split Sleeves: — Inspection may disclose that a short axial section of a shaft has been damaged too seriously to be helped by metal plating or spraying. If an adequate shaft diameter for strength remains after the damaged material has been machined off, a heavy split sleeve of one of the corrosion-resistant materials fitted over the affected area is effective in retarding further deterioration.

In a typical case in which the original shaft profile was restored exactly, the damaged shaft material was first turned down. The blank split sleeve was then fitted on the shaft and welded along its longitudinal joints. It is advisable to confine the welding to the sleeve butts; the sleeve should not be welded to the shaft itself. Asbestos wicking at the root of the V-groove was used for this purpose.

Welded sleeve was then doweled to the shaft to prevent rotation, and the heads of the dowels were welded over. The sleeve was finished machined to complete the job. This method is particularly adaptable to restoring projecting shaft details such as gland runner acorns or retaining flanges which have become unusable. For this application these details are integral with the repair sleeve.

Stellite Welding: — As might be anticipated, last-stage buckets of condensing steam turbines are vulnerable to water cutting. Where the moisture content of the steam in the last few stages runs high, damage may be severe. Fig. 6 shows a typical case of heavy erosion at the leading edges of last-stage blades.

Obviously, the way to prevent this condition is to eliminate the moisture. But despite provision in the design of lower-half cylinder drains and annular drainage passages in the shell, water accumulation persists. Protection of the buckets themselves then presents itself as a feasible alternative.

For this purpose manufacturers employ a stellite strip let into the leading edge of the bucket in the area where erosion is most pronounced. The stellite strips or inserts are silver-brazed to the buckets. A highly abrasion- and erosion-resistant surface is thus presented to the moisture-laden steam.

Although the stellite insert itself stands up well in this application, differential erosion attacks the contiguous bucket material and the silver solder of the joint. In time, the weakened welds fail and the inserts tear loose and must be replaced. Another alternative which has met with some success is hard-surfacing the critical bucket areas by means of stellite welding. The damaged edge of the bucket is ground back to provide a surface of clean metal.

Then a $\frac{1}{8}$-in.-thick build-up of stellite is applied along the edge using No. 6 filler rod and an oxyacetylene torch. A "heat-stealer" in the form of a heavy block of copper should be held in contact with the blade during welding, in order to minimize the undesirable effects of heating on the structure of the parent blade material.

Both hard-facing and inserts were used on the wheel of Fig. 6. No evaluation of either method is available at present, as adequate comparison is not yet available.

Turbine Blading Repairs: — A few years ago, the h-p stationary blading of a 160-mw cross-compound turbogenerator suffered the heavy damage shown in Fig. 9. In this instance because the capacity was urgently needed, waiting for replacement blades was out of the question. Inasmuch as all the broken blade pieces were retrieved and had not been battered beyond reclamation, it was decided to repair the blades by welding.

Accordingly the root ends were re-

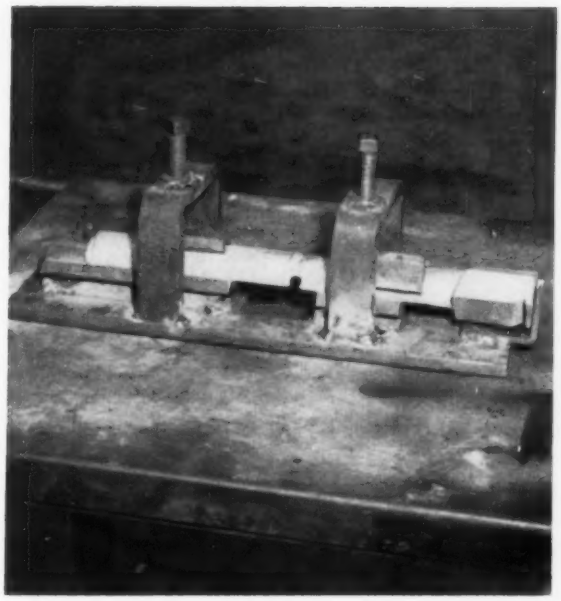


Fig. 8. (Above) Welding fixture used to butt-weld the fractured stationary high-pressure turbine blades removed from casing at right. Fig. 9. With capacity urgently needed, it was mandatory to get this unit on line as soon as possible

moved from the cylinder groove, blasted with aluminum oxide and matched with their corresponding upper ends. The abutting ends of each blade were chamfered down and the two pieces assembled in a welding fixture to maintain alignment and length. This is shown in Fig. 8. The blades were preheated to 500 F and then welded by electric arc using a 12 per cent chromium electrode (E-410). The blading material is very close to a type 403 stainless steel and is air hardening. A normalizing treatment was applied by heating to 1450 F and cooling in air. Surplus weld metal was ground off to restore the blade contour.

After this the blades were straightened in a forging die, heat treated in a fused salt bath at 1750 F, then oil-quenched. This final treatment brought the Brinell hardness to the specified value of 230. All blades were inspected for defects by the magnetic-particle method. Several hairline forging cracks were found in the thin, trailing edges and were ground out.

Prior to undertaking this welding repair, several discarded blades of the same material as the broken blades had been welded and subsequently inspected and tested to determine the validity of the method. Tensile test specimens showed an acceptable ultimate of 100,000 psi. Brinell hardness fell within the required 217 to 248 range and satisfactory ductility was demonstrated via a makeshift bend test.

All 22 blades repaired in this manner have given satisfactory service since 1952. It is estimated that this method of *continued on page 130*

Figs. 10 and 11. When welded joints in Schedule 160 stainless steel pipe began showing numerous circumferential and lesser cracks, repairs required a combination of techniques, patience and perseverance. Some penetrated completely

Fig. 1. Aerial view of UCLA Medical Center, on thirty-five acre tract on the south portion of the University campus. Pre-planning paid off in this project

How We Planned the Power Facilities Of UCLA Medical Center

Close coördination between engineer, architect and designer results in very efficient hospital power facilities. Early studies permit advance operating budget preparation, and maintenance data sheets. Hospital has unique arrangement for emergency-lighting cut-over

By KENNETH M. BRADY *

THE DREAM of a great medical center at the University of California at Los Angeles, to serve the fast growing population in the southern part of the state, started to become a reality in 1946. After considerable study, the decision was made by the Regents to locate the medical center on a thirty-five-acre site on the south portion of the campus, instead of several possible off-campus locations.

It was decided during the early development and planning periods to assign a representative of the Buildings and Grounds Department to this project, to work closely with the various representatives of the executive architects, to study the design features, and to visualize and anticipate how his future operation and organization would have to be tailored to meet this specific new academic need. Through this close coördination and relationship between the designing and operating departments, many desirable building features, from the standpoint of physical plant operation, have been incorporated within the building.

With this portion of the program well under way, and being somewhat of the opinion we could have the type of building (and the type of equipment) we preferred, the way opened for our next move in organizing for the future. Our first step was to determine the eventual occupancy of each area within the medical center. It was decided that it was best to prepare reduced scale, ⅛-in. plot drawings, shading the areas (in various colored crayons) to be occupied by the several divisions; these were to be either self-supported, or budget-supported areas. The self-supported areas were to include the hospital and outpatient clinic. The budget-supported areas were to include all academic divisions, and the various divisions of the business office, as well as all classrooms and auditoriums. A different color was selected for each of the three basic budget areas: hospital, outpatient clinic, and business office.

Utilities Allocated by Areas

Through administrative policy it was decided that all utilities (steam, electricity, water, and gas) would be recharged to the several budgets. It became a problem to establish an equitable distribution of steam and electricity consumption, since the metering systems were not related physically to the budget area. Gas and water were metered more equitably.

Under the administrative agreement, the hospital and outpatient budgets were to support all utilities. Business office costs for comfort and light were to be supported by the physical plant utilities budget, with the exception of utilities used exclusively for laboratory purposes in the academic areas. These were to be supported by the academic departmental budget. This meant distributing the total consumption of each meter to one or all of four separate accounts.

To accomplish this, additional scale drawings were prepared. One to show the area served by each of the supply fans for the heating and/or cooling of an area, to establish charges for steam used for heating or cooling. The second one was an electric lighting distribution drawing that indicates the area metered by each of the lighting meters. After the preparation of these two basic steam and electrical distribution prints, it

* Senior Supt., Bldgs and Grounds

became apparent that the areas metered were not in total relationship to the budget area; therefore, it became necessary to develop a transparent overlay of the budget area drawing.

By placing the transparent overlay on either the steam or electrical distribution prints, we were in a position to evaluate the total square footage of each metered area, or area served, and to thus distribute to the appropriate budget responsibility. In addition to the square foot evaluation it was necessary to establish a weighted factor for use in billing. An example: for the electricity used in a finished area when compared with an unfinished area; or with a high-level of illumination in some areas versus low-level in others. Shown are portions of actual charge sheets for steam (Table I), and electric power (Table II). The percentages shown in the last column are used as a basis for allocation of steam and electricity.

Table I. Distribution sheet which allocates steam charges to various departments of the hospital (Building floors are indicated as B-A-1-2-3-4, with areas noted)

STEAM

Meter Number		B	A	1	2	3	4	Total Sq Ft	% of Whole	Weighted for Billing
Hospital	U	17,020	53,158	5,133	1,064	1,225		77,610	21%	11%
	H	71,720	36,633	49,053	34,614	32,992	34,300	259,312	68%	78%
	OPD	14,846	4,152	8,372	8,100	8,221		43,691	11%	11%
	Med									
TOTAL		103,586	93,953	62,558	43,778	42,438	34,300[1]	380,613	100%	100%
Medical School	U	36,240	8,492	67,432	65,088	71,094	11,760	260,106	89%	79%
	H	4,652	16,496	7,020	1,674			29,842	10%	10%
	OPD			800				800	1%	1%
	Med									10%
TOTAL		40,892	24,988	75,252	66,762	71,094	11,760	290,748	100%	100%
Refr. Unit	U	34,152	39,468	32,840	13,152	11,792	11,760	143,164	61%	61%
	H	40,886	17,760	3,312	7,052	2,600		71,610	31%	31%
	OPD	15,208	3,820					19,028	8%	8%
	Med									
TOTAL		90,246	61,048	36,152	20,204	14,392	11,760	233,802	100%	100%
Cancer Research	U	986	4,800	4,800	4,800	4,800		20,186	100%	90%
	H									
	OPD									
	Med									10%
TOTAL		986	4,800	4,800	4,800	4,800		20,186	100%	100%

Hospital Total Square Footage	297,375	44%	
OPD Total " "	36,270	5%	
Steam Total " "	337,716	51%	
TOTAL	671,361	100%	

Table II. Electrical energy distribution sheet which allocates consumption, on square-footage basis, to various hospital departments. Includes mechanical equipment

ELECTRICITY

Meter Number		Floors B	A	1	2	3	4	Roof	Total Sq Ft	% of Whole	Weighted for Billing
24-4-H1	U	4,013	13,266	2,016	176	504	480		20,455	14%	4%
	H	39,447	17,090	25,826	13,484	8,102	16,560	3,080	123,589	86%	82%
	OPD										
	Med										14%
TOTAL		43,460	30,356	27,842	13,660	8,606	17,040	3,080	144,044	100%	100%
24-5-H1	U	2,696	7,536	5,144	600	600			16,576	11%	7%
	H	14,406	41,332	26,338	17,300	16,000	15,936	520	131,832	88%	92%
	OPD			800					800	1%	1%
	Med										
TOTAL		17,102	48,868	32,282	17,900	16,600	15,936	520	149,208	100%	100%
24-6-H1	U	4,020	11,800	8,316	8,794	7,617			40,547	39%	21%
	H	15,536	1,632	1,104				1,680	19,952	18%	30%
	OPD	14,944	4,680	8,714	8,200	8,221			44,759	43%	46%
	Med										3%
TOTAL		34,500	18,112	18,134	16,994	15,838		1,680	105,258	100%	100%
24-7-S1 Elev Fans	U										100%
	H										
	OPD										
	Med										
TOTAL											100%
24-7-H1 Elev Fans	U										90%
	H										10%
	OPD										
	Med										
TOTAL											100%
24-8-S1	U	986	4,800	4,800	4,800	4,800		535	20,721	100%	45%
	H										
	OPD										
	Med										55%
TOTAL		986	4,800	4,800	4,800	4,800		535	21,721	100%	*100%
Cumulative Total		175,676	177,949	152,393	118,408	115,085	44,736	9,581	793,828	*100%	
Hospital	"								331,426	42%	40%
OPD	"								37,338	5%	10%
Utilities	"								425,064	53%	50%
									793,828	100%	

Evaluation of Power Facilities

After this part of the plan was established, our next move was to evaluate the total building mechanical and electrical equipment, to be able to prepare preliminary budget estimates for the various budget-supported divisions.

The building power equipment consists of over thirty major supply fans, ranging from 6000 cfm to over 37,000 cfm. All supply fans are equipped with heating coils, and some are equipped with cooling coils (for chilled water air-conditioning system), and with additional pre-heat and re-heat coils. There are approximately thirty major exhaust fans, with the maximum size running over 40,000 cfm; also, there are approximately fifty smaller individual units for exhausting elevator pent houses, transformer vaults, toilet rooms, etc.

General supply and exhaust systems basically serve the lower levels; such as B, A, and the first floor, with the exception of the areas where special systems have been designed for specific temperature and humidity control. The heating and ventilation of the patient rooms, and small offices on the upper floors, is accomplished with individual unit ventilators, of which there are over three hundred.

Special Data Sheets Prepared

Table III is a data sheet for a typical surgery supply fan. This sheet covers all vital operational information, such as power and control sources. Each piece of building equipment, such as hot water circulating pumps, vacuum return pumps, humidifier spray pumps, electric drinking fountains, refrigeration units, pneumatic tube systems, and special temperature rooms are all treated in essentially the same manner.

Table IV shows the data sheet on a special temperature room, of which there are thirty-three. Approximately 2000 pieces of equipment were involved in the original survey. This information minimizes trouble-shooting, in the event of failure of any component. The sheets are posted at the equipment, for ready reference.

In addition to the above listing, a manpower-service requirement was established for each item of building equipment. These were then compiled as to the budget-supporting group; and listings were made of equipment, followed by the outline of routine, daily, or otherwise scheduled inspections and service. These were further converted into hours of annual labor.

From this, we were able to apply the existing hourly rate of the labor craft involved, and establish annual estimates for the service of these various pieces of equipment. Other items of building equipment, such as hot-water generators, water softeners, stills, emergency-water systems, autoclaves, and sterilizers, were given similar treatment for operational and budget information.

Table III. Typical equipment data sheet showing pertinent information applying to a Supply Fan. This sheet is posted near equipment, and is on file in office

Medical Center Equipment

Supply Fan S-19

Location	Room A4-165
Area served	Surgery rooms (B-2)
Remote control	Switchboard PP 2 Room B6-511
Mag & bkr loc	Switchboard PP 6 Room A4-141
Power source	P 613 Switchboard PP 6 Room A4-141, PF 31C Switchboard #3 Room A3-143
Power metering	Hospital 480 3-phase
Fan cfm	13,650
speed	310
Motor speed	1800
Type	Synch
hp	5
Voltage	480
Phase & cycle	3-phase 60-cycle
Filter size	20 X 25
Filters required	6
Steam	Preheating & reheating
Cooling	Chilled water
Note	Exhaust from this area is by X-9

Table IV — Right. Equipment data sheet specifically for Special Temperature Rooms. As several items of equipment are involved, additional maintenance data must be supplied for operators who will service the units

Medical Center Equipment

Special Temperature Rooms

System No.	D-R-20
Service	Medical School, constant temperature room
Location	Room 32-173 Unit 3-6
Temp range deg F	Plus 104 to Plus 24.8 F
Allowable variation	Plus or minus 3.6 F

Compressor

Location	In elevator penthouse on roof above
Make	York 20 M-W
Capacity, Btu per hr	17,330
Rpm	635
Motor hp & voltage	3 hp, 208-v 3-Phase 60-Cycle
Magnetic & bkr Loc	Recording control panel #2 in room 32-173
Power source	Panel P3BG Outside Room 32-167, Cir #12, from PD36B Outside Room 32-164, Cir #7, from LF #152 in Transformer Rm. A2-170 on Sw Bd P6.
Power Metering	Hospital

Air Coolers

Capacity, Btu per hr	16,600
Fan hp	1/15th (2)
Defrost	Automatic-water

Heating Equipment

Kw & voltage	2.5 kw 208-v 3-Phase 60-Cycle
Power source	Same as Above
Power metering	Hospital
Fan hp	

Recording controlling

Recorder controller note: This unit contains a ventilating fan, steam preheat coil & steam injection humidifier

Air conditioning is achieved by a chilled-water system to the air-supply fans serving the area. Water for the system is chilled by a 550-ton centrifugal compressor, driven by a 560-hp steam turbine, taking steam at 125 psi and exhausting at 27-in. vacuum.

Water in the air conditioning refrigeration cooling tower, the chilled-water circulating system, and the make-up water, is tested at least daily by the power engineers. The test includes those for pH, chlorides, and phosphates in the cooling tower water; for pH and chromates in the closed chilled-water system; and for pH and chlorides in the make-up water. As determined by these tests, sulphuric acid is added to the tower water to maintain a pH of 7.5 to 7.7. A poly-phosphate organic compound is added to maintain a phosphate reading of 25 parts per million, to control scaling. Bleed-off, or blowdown, is controlled to hold the chlorides concentration in the tower-water at five times that of the make-up water. To control corrosion in the closed chilled-water system, chromate is added to maintain a concentration of 600 parts per million, and pH is maintained at 8.2.

Electrical Equipment

Electricity is supplied to the University campus central sub-station at 34,500 v, 3-phase, 60-cycle. We are served by two separate sources; the capacity of this substation is 10,000 kva, arranged in two closed-Delta banks of 5000 kva each. The feeder breakers, transformer primary breakers, and a tie-breaker, are arranged in a conventional "H-pattern." This is to permit operation of either transformer on its own feeder, operation of both transformers on either feeder; or tie both the feeders and the transformer primaries in parallel.

Secondary voltage of the two banks is 4800-v, 3-phase. A similar type of bus transferring on the secondaries has been incorporated, to enable service-switching to four separate feeders. Through this arrangement, one bank may be de-energized for servicing and cleaning, while the load is carried by a single 5000 kva bank. Of the four 4800-v feeders, two are serving the general campus exclusively, while the other two feed building groups and the medical center. These latter two feeders go to a separate distribution board at the substation, and are routed to the medical center — through disconnects and over-current relays.

Primary feeders for the emergency-lighting transformers are parallel with feeders which terminate in our automatic emergency-transfer panel, located near the main medical center distribution switchboard. In the event of failure on any of these primary or secondary services (as related to the high voltage transformer), the control panel for emergency power will detect this abnormality, and will close a circuit which energizes a solenoid. This, in turn, opens the steam supply of a turbine-driven, 375 kva, 480-v, 3-phase, 60-cycle emergency generator. This automatic transfer from normal to emergency, averages 13 seconds. Periodic testing of this emergency-transfer equipment insures its reliability.

As to the several piping systems, we were in a position to observe, throughout the construction stages, the installation of the major pipe routings for steam, gas, industrial, and domestic water system. Drawings were made indicating the various shut-off points. Drawings were also made showing the control points for all major lines, and for the areas which were protected by automatic sprinklers, along with their water-flow alarms and shut-off valves.

The building piping system has approximately 30 miles of copper pipe, 25 miles of steel pipe, and nearly eight miles of cast iron waste-line. Knowing we were now in a position to say we had sufficiently analyzed the major items of building responsibility, and having a fair idea as to our total manpower requirements, we were in a position to then proceed with our own medical center maintenance shop and office facility.

Approximately 5000 sq ft were assigned for this activity; it included an office for the Superintendent of Buildings & Grounds and his staff, and an area adjacent to the air-conditioning equipment for the power engineer's responsibilities and functions. Shop facilities for electricians, plumbers, mechanics, carpenters, and painters, with an area set-up for the building custodians also were provided. THE END

How System Changes Affect Operation of Pumps in Parallel

Next time you plan to use parallel pumps in a system, or have troubles due to improper load division, sit down and run this analysis

By PAUL N. GARAY

AS THE OPERATOR of a plant using centrifugal pumps, you may some day be confronted with the problem of operating several pumps in parallel. This can be done, especially if the pumps have similar characteristics, but there are variables involved which cannot be casually foreseen. A change in any condition defining a pump system is liable to change so many of these variables that some kind of analysis is necessary if possible troubles are to be anticipated and answers found to the problems of undesirable operating conditions.

As an example, consider the problem of two centrifugal pumps feeding a boiler through a common line. Assume that one is a constant speed motor-driven pump, and the other is a variable speed turbine-driven pump.

As the first step in analysis, it will be necessary to lay out a simple "head capacity" curve for the piping system, which is usually referred to as a "system curve." The effect of the valves and fittings in the piping is introduced by assigning an "equivalent length" to each such fitting, and adding all these equivalent lengths to the actual piping length to obtain an overall length of the system for calculation purposes. The most familiar source of this information is the familiar chart which originated with the Crane Co (Fig. 1).

Having calculated the total equivalent length of the discharge system, the friction head at any flow can be obtained by the use of the nomogram in Fig. 2.

The friction head is actually the pressure that causes the fluid to flow through the system. These values can also be found in technical literature worked out in numbers and conveniently tabulated. We can now plot the system curve, Fig. 3.

Note that the system curve starts at the static pressure of the system.

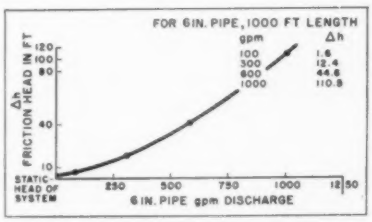
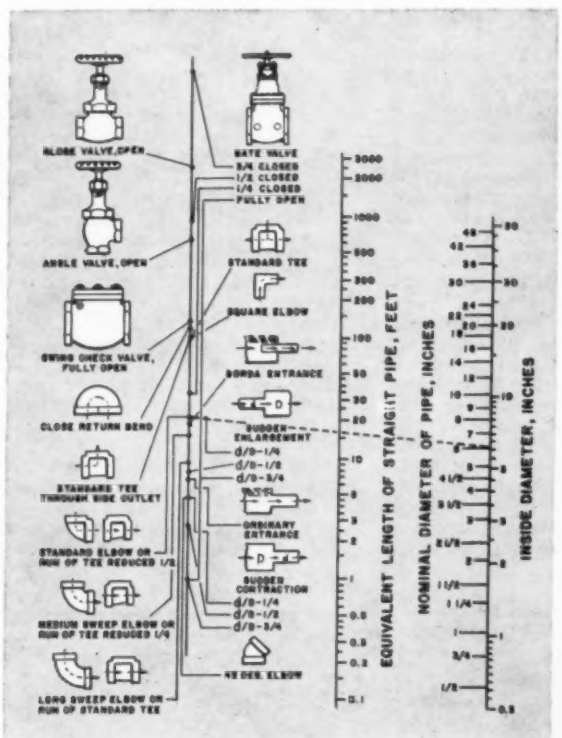


Fig. 3. Note that system curve starts at the static pressure of the system



Courtesy Crane Co.

Fig. 1. Simple way to account for resistance offered to flow by valves and fittings is to add to length of pipe in the line a length which will give pressure drop equal to that which occurs in valves and fittings. Example: dotted line shows resistance of 6-in. Standard Elbow is equivalent to approximately 16 ft of 6-in. standard steel pipe

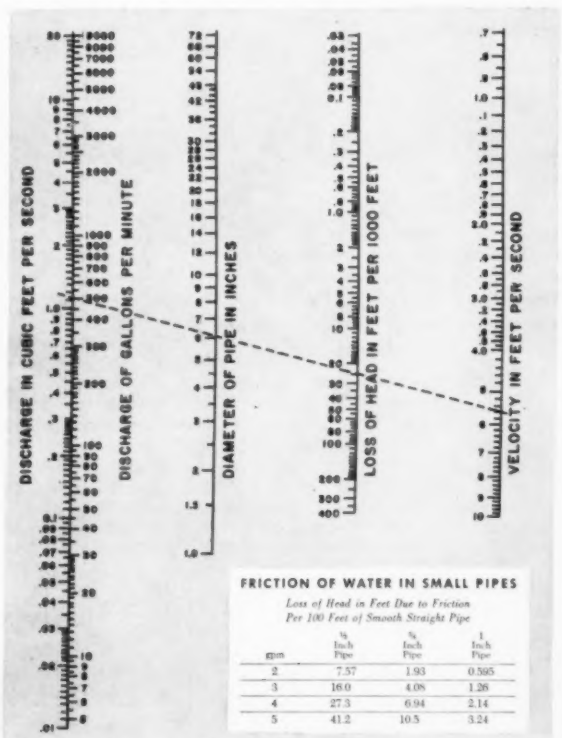

DISCHARGE IN CUBIC FEET PER SECOND
DISCHARGE OF GALLONS PER MINUTE
DIAMETER OF PIPE IN INCHES
LOSS OF HEAD IN FEET PER 1000 FEET
VELOCITY IN FEET PER SECOND
FRICTION OF WATER IN SMALL PIPES
Loss of Head in Feet Due to Friction Per 100 Feet of Smooth Straight Pipe
gpm
¾ Inch Pipe
1 Inch Pipe
2 7.57 1.93 0.595
3 16.0 4.08 1.26
4 27.3 6.94 2.14
5 41.2 10.5 3.24

Fig. 2. To calculate pipe sizes, discharge velocities and loss of head in standard steel pipe, lay straightedge on scales at points for any two known quantities. Unknown quantities will lie at intersection with other scales. For loss of head in cast iron pipe, multiply loss of head in steel pipe by 1.5; by 2 for loss in concrete pipe

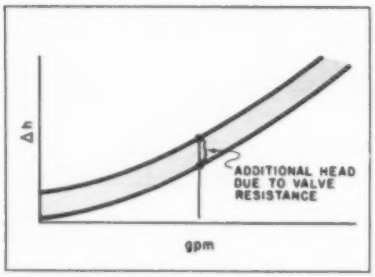


Fig. 4. System curve with pressure head due to valve restriction added

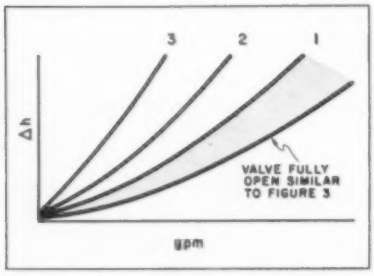


Fig. 5. If control is the minimum, it will vary the system head, as shown

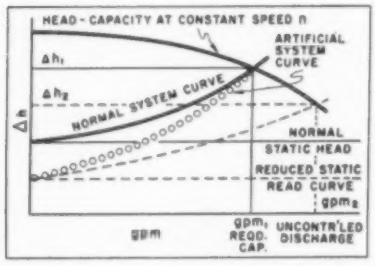


Fig. 6. Several factors affecting performance. Uncontrolled discharge is due to condition of reduced static head

That is, if we are pumping against 800 psi boiler pressure, the curve of Fig. 3 would start at 1920 feet, which is the equivalent of 800 psi. We will treat the pump curves in the same way, showing only the part of the curve above static pressure.

Any change in the system conditions can now be represented on Fig. 3. Suppose the line terminates in a feedwater regulator, which is only partly open. The pressure head due to the restriction in the valve is then added to the system curve, which will then look like Fig. 4, which shows a control based on a constant drop across the regulator.

The amount of pressure drop due to the valve may assume any line dependent on the control characteristics. The solid lines of Fig. 4 show a constant pressure across the feedwater regulator. If the control is the minimum, it will consist only of the boiler feedwater regulator, and will vary the system head as shown in Fig. 5.

The curves 1, 2, and 3 show the system at various positions of valve closure. Distinction is sometimes made between "system friction curve," which is a plot of the friction losses only, and the "system head curve," which is a plot of the friction losses plus the total static head. We are now only concerned with the first, which we are calling the "system curve."

The shaded area in Fig. 4, and below curve 1 in Fig. 5, represents the throttling loss through a partially closed valve. The amount of closure necessary to cause a given pressure loss at a certain gpm is obtainable from a valve characteristic chart which is available for each control valve.

Now consider the pump curves. Each centrifugal pump has a performance curve showing the relation between head and capacity at a constant speed. Since the curve for other speeds is similar, it is a simple matter to plot several curves to represent head and capacity at other than standard speeds. This will be shown shortly.

Several of the factors affecting pump performance are plotted in Fig. 6. Note that we are concerned with static head only to the extent of showing what happens if it is reduced somewhat. The plot shows a normal head capacity curve for a pump and system (solid lines). The dashed lines show the effect of reducing the static head. A new operating equilibrium would be established, having a discharge, gpm_2, which is not what the boiler requires. The regulator valve therefore closes to establish an artificial system curve (dotted line) which returns the delivery to the desired point, gpm_1.

Remember that for a single-speed pump, flow regulation occurs as the result of a change in the head. The head change can be effected by throttling in the discharge line, by restricting the suction (not as desirable due to flashing), or by changing the static head (which is usually an incidental rather than a sought for effect). The bare curve in Fig. 7 illustrates this clearly.

Suppose now that the pipe is governed by a constant pressure regulator. The system conditions could be plotted as shown in Fig. 8, in solid lines.

Since the discharge of the condition at Fig. 8 is controlled only by the system conditions, in order to control the flow it is necessary to close the feedwater regulator valve (which was not shown in Fig. 8) to establish a desired flow. This is shown in Fig. 9.

Figure 10 is another example of how to show system conditions by the plot of a control which utilizes an excess pressure regulator on the pump, and a feedwater regulator. Figure 10 shows what happens. Note that in this case, even though pressure drop across the feedwater regulator is constant at all loads, opening or closing of the valve changes the system curve to adjust delivery (dashed lines).

All of the conditions shown so far have depended for control on throttling the flow at one point or another, with a consequent loss in power, as shown by the shaded areas in the curves. How can we reduce this power loss?

This can be done by regulating the pump speed. We have plotted a typical pump curve, as obtained from the pump manufacturer, and can next make a plot of head capacity at various speeds by the following method:

For any centrifugal pump, if gpm and h are the original speed conditions rpm, and gpm_2 and h_2 are the conditions at reduced speed rpm_2, then

$$\frac{gpm_2}{gpm} = \frac{rpm_2}{rpm}, \text{ and } \frac{h_2}{h} = \left(\frac{rpm_2}{rpm}\right)^2$$

This relationship holds throughout the entire practical pump range, so that if we know the characteristics at one speed, we can calculate the curve

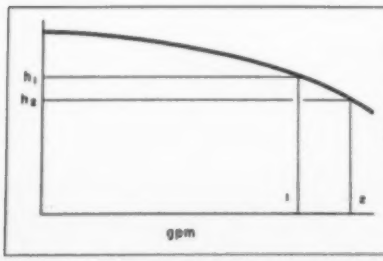


Fig. 7. Curve shows how head change can be effected by discharge throttling

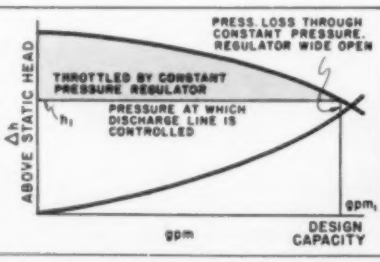


Fig. 8. System conditions if pump is governed by constant pressure regulator

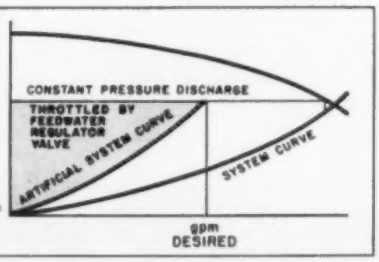


Fig. 9. Closing the feedwater regulator valve will establish a desired flow

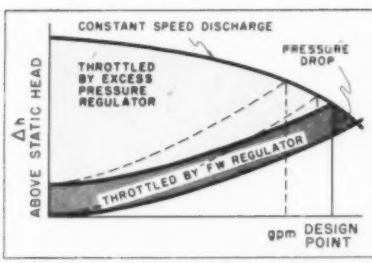


Fig. 10. Another example of control using an excess pressure regulator

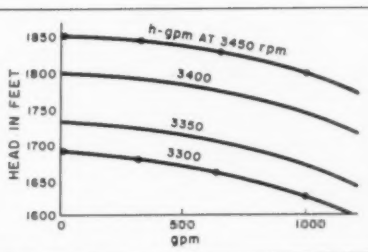


Fig. 11. Series of head capacity curves for various speeds, spacing uniform

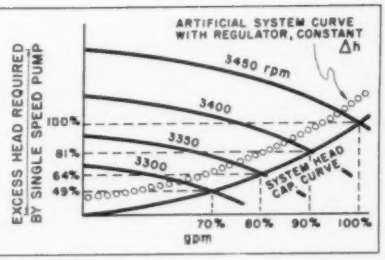


Fig. 12. This shows how variable speed pump behaves when operating in Fig. 11

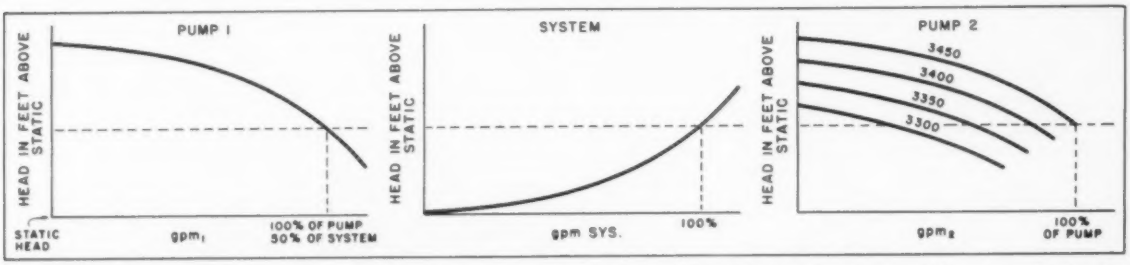


Fig. 13. To study mutual behavior of two pumps in a system, make three plots as shown. Base line and H on same horizontal

for any other speed. Assuming speeds of 3450 and 3300, the speed ratio is:

$$\frac{3300}{3450} = .956, \text{ and } .956^2 = .915.$$

Accordingly, the capacities will be reduced by the ratio of .956, and the heads will be reduced by the ratio squared or .915. Let us tabulate our calculations:

AT 3540 RPM		Multiply gpm by .956	AT 3300 RPM	Multiply h by .915
gpm_1	h_1 in ft.		gpm_2	h_2 in ft
0	1850		0	1691
300	1842		287	1685
600	1825		573	1669
1000	1782		956	1630

Any other speed conditions can be similarly and easily tabulated. (Note: curve should correspond to numbers within accuracy of a pencil line.)

Using the tabular method, make up a series of head capacity curves for various speeds, as shown by Fig. 11. Note that the spacing between curves is uniform, but logarithmic. Label each curve with its speed.

Now, how does such a variable speed pump behave in the system? Put the pump and system curves together, as in Fig. 12. Notice that for any required delivery, the pump head is just exactly enough to put out the required flow. There is no excess pressure to be throttled. A single-speed pump would have to be designed for the excess head shown in Fig. 12, in order to deliver at full capacity, but the variable speed pump is required only to put out a maximum head as shown by the 100 per cent of H, Fig. 12. Operation of such a pump can be cheaper, as well as first cost, if substantial heads are involved.

In practice, a feedwater regulator is usually included in the system, and its effect is shown by the dotted line of Fig. 12. Pump in this case is controlled to maintain a constant pressure drop across the regulator. Capacities are determined by the intersection of the pump curves with the dotted line. Pump head pressure available, of course, must be enough to compensate for this added loss.

Since the purpose of this article is to study the mutual behavior of two pumps in a system, let us proceed as follows:

Make three plots as shown, for pump 1, pump 2, and the system (see Fig. 13).

In such a plot, the output of the two pumps must equal the system output, or:

$gpm + gpm_2 = gpm$ system, and

$h_1 = h_2 = h$ system.

It is also convenient to think of pump delivery in terms of the system, rather than of the individual pump. Thus if we speak of a 50 per cent delivery, we will mean that the pump is putting out 50 per cent of the system capacity.

Remember that if we have one system, all the pressure heads should coincide, as shown by the line on the previous figure. Remember also — $gpm_1 + gpm_2$ should always equal gpm system.

To make the system realistic, let us add now a drop due to the control valve *continued on page 136*

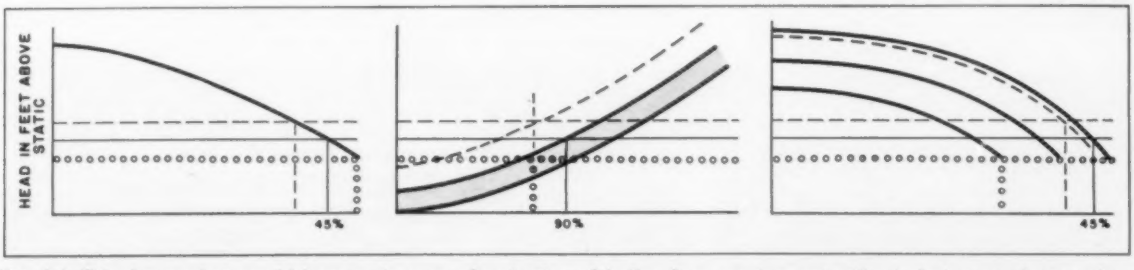
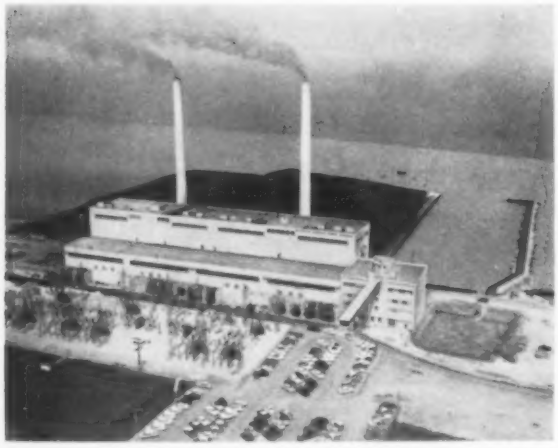


Fig. 14. This shows what would happen in case of reduction of boiler flow requirement without closing regulator valve, reduction of flow requirement by closing feedwater regulator, and opening feedwater valve to permit increased flow

POWER ENGINEERING'S

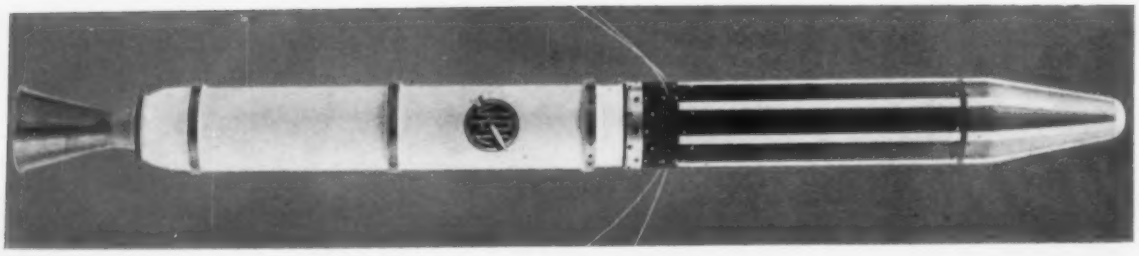


Wisconsin's largest power station, the 500,000-kw Oak Creek plant of Wisconsin Electric Power Co, will get even bigger when $39,500,000 addition (excavation right) is completed in 1960. It will house a 250,000-kw Allis-Chalmers center-line-at-floor-level steam turbine generator

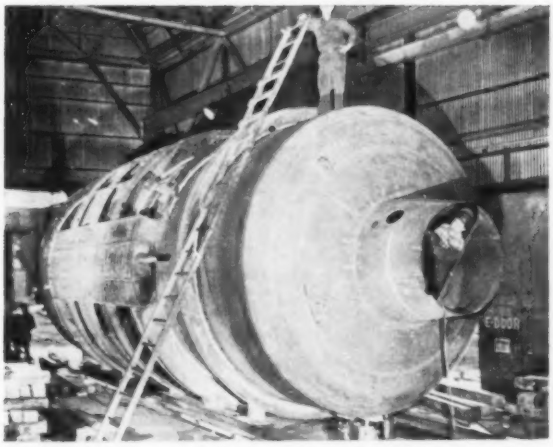
Tokyo bound is this 330,000-lb boiler drum 67 ft long made by Babcock & Wilcox in Ohio for Chiba Thermal Power Station in Japan. It's said to be the largest and heaviest boiler drum ever to be exported from the United States

Stepping across water, these 115,000-v transmission lines negotiate the half mile across Casco Bay near Yarmouth, Maine. Central Maine Power Co engineers set these towers on 60-in. concrete on steel H piling 75 ft deep

Explorer's nose cone and instrument section are partially covered with stripes of an aluminum oxide coating made by Norton Co, to help control temperature of instrumentation inside the satellite. Striping keeps temperature between 50 and 86 F. Below it is the 4th stage rocket motor section, which remains attached to cone in orbital flight of 18,000 mph



NEWS REEL

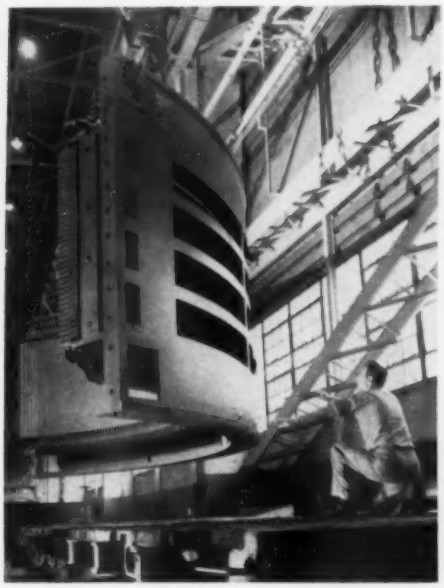


Inside man, Paul Young of O. G. Kelley & Co, stands only 38 in. tall in his safety shoes, is believed to be the world's smallest welder. He's completing work here inside a 40-ft Lukens T-1 (high yield strength) alloy test chamber to be used for development of aircraft nuclear engines

Aluminum bus conductor, in jumbo size, is being produced by Harvey Aluminum for its primary reduction plant at The Dalles, Oregon. The bus bars measure 4⅛ in. by 20 in., with lengths up to 43 ft. Over 10,000,000 lb of aluminum were extruded in bars designed to serve high voltage systems

British Information Services

Dome of Dounreay, Britain's fast breeder reactor, looms up on the northern coast of Scotland. The 135-ft sealed sphere will house reactor which will depend on unslowed neutrons for its chain reaction. Dounreay, described fully in Nov 1957 issue, to be completed by end of this year



50-ton section of a waterwheel generator stator is swung onto flatcar in Westinghouse's East Pittsburgh plant for shipment to project in Oregon. This section with two other identical units forms the complete stator for a 100,111-kva generator. Water-driven turbine powers rotor inside stator

AIEE Winter Meeting Attracts, Rewards 5000 Electrical Engineers

WITH THE LARGEST number of technical sessions ever organized for an Institute meeting, and an array of inspection trips in the New York area which offered incentive to the most experienced of the group, the AIEE Winter General Meeting was one of the most successful of all time.

In spite of the appearance of a vehement flu bug, which kept both the principal speaker and the President of the Institute from the General Session on opening day, the enthusiasm of those present was not dampened. Arthur Watson, president of World Trade Corp, delivered the address of his brother, Thomas J. Watson, president of IBM. He called for the immediate raising of salaries by 40 per cent or more in the teaching profession.

This is his answer to the long-term problem of competing with Russia, but he feels that it must be done immediately to attract and hold the quality and quantity of individuals necessary. He comes to the conclusion that it must be done with a federal subsidy.

In the absence of President Barrett, J. H. Foote, AIEE Vice-President, ably assumed the duties, and presented to John Hodnette, executive vice-president of Westinghouse, the Edison Medal, highest award of the AIEE. Mr. Hodnette, in receiving the recognition, asserted his belief that the shortage of engineers is destined to continue for a minimum of two decades — and the shortage of really creative engineers will last forever.

"To maintain our rate of national growth," said Mr. Hodnette, "we are going to have to increase our productivity per worker by almost two-thirds — and the problem will be much harder if the work week is reduced. That means better machines, and more and better technicians, engineers and scientists to design, build, maintain and run them."

Other opening day events included awards to authors of prize-winning papers, and the report of the nominating committee. L. F. Hickernell, who is vice-president-engineering of Anaconda Wire and Cable Co, was nominated as president-elect. For the Board of Directors, Wm. A. Lewis, Norman F. Rode and Eugene C. Starr, were nominated. They are associated with Illinois Institute of Technology, Texas A & M, and Bonneville Power Administration, respectively.

Also nominated with this group were the vice-presidents for the various districts which comprise the international Institute.

So great was the scope of the meeting that high-lights were difficult to distinguish, except in regard to specific fields. Some of these, of interest to the power engineer, are outlined here.

Fig. 1. John D. Hodnette, left, executive vice-president, Westinghouse, receives Edison Medal from AIEE v-p J. H. Foote Medal is the Institute's highest award

Heat Pumps in Industry

While heat pumps gained their initial momentum in moderate climates, developments now on the market make them competitive in areas where ambient temperatures become as low as −20 F, R. G. Werden, York Corp, stated. Extraction of heat from the air, and its subsequent use to heat water was described, as well as the reverse of this process. A number of other advantages of the air-source compound-cycle system were pointed out by the author.

H. E. Rex, of Carrier Corp, discussed the use of large heat pumps, those with a capacity of over 100 tons. Most intriguing is the application in industrial processes, where a heat pump can simultaneously provide heat extraction and heat addition. A number of successful installations, such as in malting and orange juice concentrating, were described in Mr. Rex's paper.

Gas Turbines

Electrical end of the gas turbine attracted considerable attention, particularly in view of the fact that it seems to have arrived as a major prime mover for electrical production. Major utilities are studying and/or adopting it for a variety of applications. Z. Stanley Stys, Brown Boveri Corp, stated in his paper: "It is ultimately possible even to build a 100,000-kw unit which will have approximately the same space (as a 20,000-kw unit), and which would work on the principal of a combined steam-turbine and gas-turbine cycle, where the steam is generated at the super-critical conditions. An efficiency of over 45 per cent in such a cycle seems to be feasible."

Interest in technical education in foreign countries was high among the

Fig. 2. L. F. Hickernell, Anaconda v-p, who was named the president-elect of AIEE

delegates. M. G. Malti, of Cornell University, presented a paper on such training in India, as a result of two years at the University of Roorkee. The students are highly intelligent and receptive, he said, as they are selected by elimination examinations.

Indian government, says Malti, spends about 1250 per cent more of its national income on technical education than does the United States.

An extensive survey by P. A. Albetti and G. F. Lincks, of General Electric, led to the conclusion that we in America must expect many "USSR technological firsts" in addition to the Sputniks. This, they believe, is due to the emphasis which the Russians have placed on science, and the length of time that this trend has been evident.

Computers Are Challenge

Computers, completely unable to think for themselves, are making engineers work overtime to present problems to them in the proper manner, a consensus of opinion seemed to say. One astute observer of the field was heard to comment "If you are in a position to consider the purchase of a computer, I can assure you that it will pay for itself — just by making you *analyze* the problems which you would program on it, even if you never put them through the machine!"

In pointing out the desirability of using the machine more and more in the operation of machinery and in the data-processing chain, S. L. Seaton pointed out that the human makes one mistake in about 200 digits transferred, while the machine makes less than one error in 10^{20} (once in every one-hundred-quintrillion times).

Expected to pay for itself in two years, the power dispatch computer of Ohio Edison was described by R. H. Travers. Maintenance experience has been comparable with other types of control and electronic equipment owned by the system.

Fig. 3. Ray Mayer, Jr., introduces "The Indispensable Man" (described in Engineers' Preview) to Section Chairmen

Use of proximity switches to detect cans in supposedly empty boxes, or the absence of a cutting edge on foil boxes, was described.

Predictions generally were that the increased use of computers and automation would tend to increase em, ployment, rather than the opposite but that the general level of the employee required would be raised considerably. This is due to the high caliber of personnel necessary to design, produce, maintain and operate the various complex types of equipment required. THE END

Fig. 4. This multi-color map of the transmission lines of the United States was exhibited by Thomas H. MacCauley of General Electric, Philadelphia. Map is lighted by ultra-violet lamps, with incandescent bulbs locating major generating stations

Gas Pipeline Power Facilities

Pipeline in wilderness area of western Canada utilizes compressor stations designed for rugged and dependable service. "Big-Inch" line of Westcoast Transmission Company opens vast new gas reserves, to serve Pacific Northwest markets in Canada and USA

By WILLIAM T. HALL *

About the Author—Power Engineer responsible for the operation and maintenance supervision of the four existing, and four future, stations on this pipeline is William Hall, Superintendent of Compressor Stations. His job involves all the functions connected with gas compressor stations, including the gas engines, compressors, starting equipment, electrical and mechanical equipment, and controls. This is no simple task, especially when the nearest sources of supply are hundreds of miles away and when roads are impassable

ONE OF THE major engineering and construction projects completed in recent years is a 650-mile gas transmission line, in the wilds of British Columbia. Built by Westcoast Transmission Co, this 30-in. line will bring the vast gas reserves from the rich Peace River fields to southwestern Canada and the northwestern United States area. It will interconnect with lines which extend down into the gas fields of Colorado, Kansas, Texas and New Mexico.

This is a conventional gas pipeline, except that it traverses some of the most rugged country in which a line was ever built. The line crosses over and under rivers, using many suspension bridges for the overhead crossings; it crosses the Rocky Mountains, too, in its course southward.

Power facilities for such pipelines consist mainly of compressor stations, which keep the gas moving through the line. These stations are self-sustaining, in that they obtain power for compression, heating, pumping, and electrical generation from the gas in the lines.

This line has four Compressor Stations. Compressor Station No. 1 is at Taylor Flats, B. C. and consists of six turbocharged, 4 cycle, gas spark ignited reciprocating engines, driving four 10½-by 15-in. reciprocating compressors. These engines are operating at a compression ratio of approximately 2:5. As is to be expected, this Station has not been in operation long enough to form any maintenance data. It has only been in operation for 60 days.

Compressor Station No. 3 is at Fort McLeod, B. C. and consists of four 3550-bhp spark-ignited gas engines with a running speed of 500 rpm, driving a De Laval 24 by 24-in. centrifugal compressor. This Station has been operating at a compression ratio of from 1:20 to 1:35. The piping of the compressors being 24 in., is looped between each compressor.

Compressor Station No. 5 at Quesnel, B. C. is identical to Station No. 3 with the exception of compressor piping. In this case the piping is installed on a straight-through design with the engine setting accommodating two 24 in. valves with one 24-by-24-in. tee for bypass purposes.

Compressor Station No. 7 at Savona, B. C. is identical to Station No. 5 but with the exception that it has only three engines and three compressors installed at this location.

The gas engines have built-in speed increasing gears and drive 24-by 24-in. compressors. Each of these V-type engines have 16 cylinders of 13½-in. bore by 16½-in. stroke and are rated 3550 bhp at 500 rpm. The single step geartrain has a 10:1 increasing ratio.

The compressors are single stage with a maximum working pressure of not less than 1000 lb per sq in. The design point of the compressor is at an adiabatic head of 6000 ft-lb per lb and an inlet volume of 5400 cfm. This results in the four unit stations having a compressing capacity of 18,000 hp and Station No. 7 having a total rating of 13,500 hp. The compressors are oil sealed and lubricated by a forced-feed lubricating system which is integral with the speed-increasing gears lubricating oil system. Incoming gas passes through scrubbers, which remove all debris and liquids, prior to compressors.

*Superintendent of Compressor Stations, Westcoast Transmission Co.

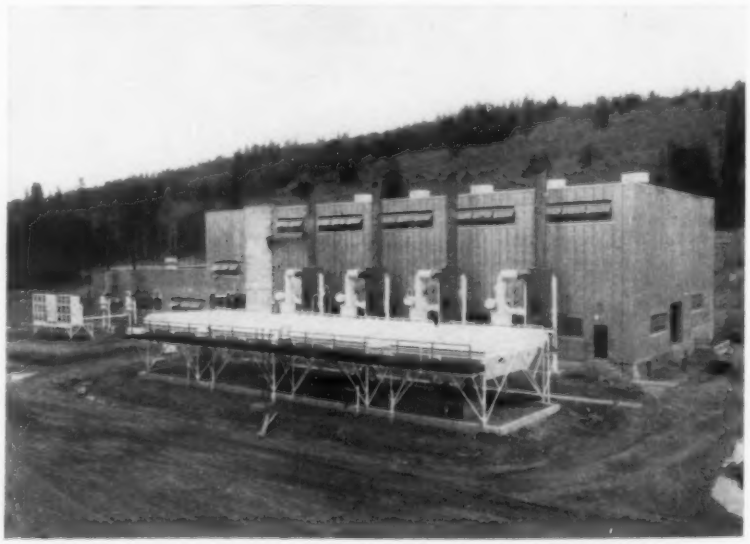


Fig. 1. One of three typical compressor stations. Each has four 16-cylinder, 3550-bhp gas engines—connected (through a geartrain) to 24-in. by 24-in. compressors

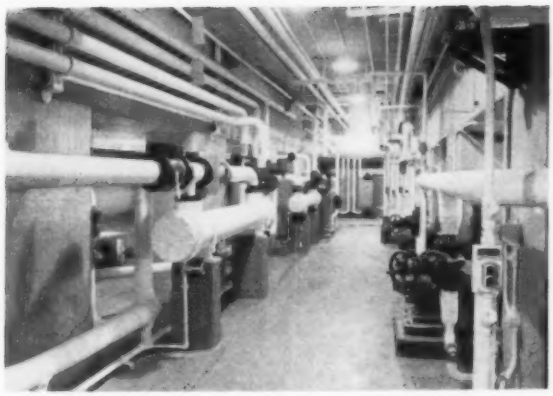


Fig. 2. View of pump and cooler galley between two gas-engine units. Note arrangement of check valves and shut-offs, installed for both ease of operation and maintenance

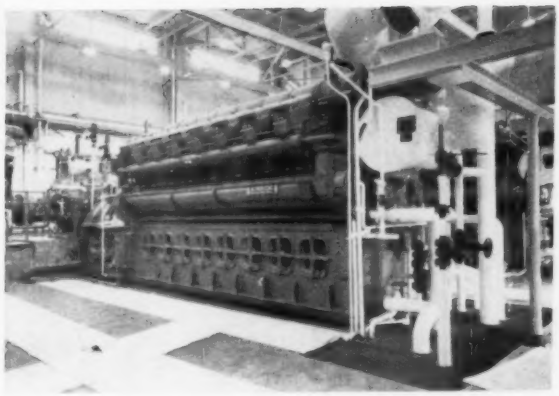


Fig. 3. Engine No. 1 at Station 5. This is typical of eleven units; it is 16-cylinder, water-cooled, with 13½-in. bore and 16½-in. stroke; the rating is 3550 bhp at 500 rpm

The four-cycle engines have circulating water cooling systems and forced feed lubrication. The main jacket water pumps are designed to circulate 658 gpm, operating at 1750 rpm against total head of 70 ft. Lubricating oil coolers were specified to handle 400 gpm and to cool oil temperature from 170 F to 156 F with 288 gpm of jacket water flowing at 134 F.

The cooling heat exchanger units have vertical air flow under forced draft. The fan is gear driven by a two-speed, 30-hp electric motor but the shutters for controlling the air flow are manually operated. The units are designed to dissipate 8.6 MBtu per hr from the 288-gpm jacket cooling water at temperatures from 170 to 110 F with an ambient temperature of 90 F.

Heat is provided by a two-pipe hot water system with the primary source of heat from engine jacket water and the secondary source from a fire tube water heating boiler with gas burners suitable for natural gas or propane gas.

Two 440-kw gas-engine-driven generator sets supply power for the station. Emergency power needs can be met by a 40-kw propane gas engine driven generator.

Compressed air, 250 psi, for starting the engines is provided by two compressors — one motor driven, the other propane-gas-engine-driven.

Water supply is from two wells each fitted with motor driven, deep well, turbine pumps. Water will be pumped to underground storage tanks of 6000 gal capacity for potable water and an 18,000 gal capacity for fire water supply. The fire protection system is supplied by two vertical turbine pumps — one motor driven, the other propane gas engine driven.

A 500 cu ft propane gas storage tank is provided at each station for the emergency or standby units which use propane gas for fuel. In addition, if the natural gas supply is cut off, the naturally aspirated engine units driving the generators and air compressors could also be readily switched to operation on this gas.

The spark-ignited gas engines are started and controlled at a point remote from the engine proper. These controls are semi-automatic at the present time but are designed for easy conversion to fully automatic, remote control. The following is the sequence of engine starting.

Automatic Operation

Before starting an engine, the operator checks the auxiliary equipment and turns the selector switches on the various motors to the automatic position. This includes the engine lube oil pump, crankcase vacuum pump, air filter pump, accessory lube oil pump, seal oil pump, auxiliary seal oil pump, discharge valve and suction valve. Selector switches for standby equipment are turned to the "off" position. The operator then pushes the pre-start button located on either the engine board or the main console and the pre-start sequence is initiated.

The crankcase vacuum pump, the air filter pump, the engine lube oil pump start simultaneously. The accessory lube oil pump starts as soon as the oil temperature at the discharge of the accessory lube oil tank is at 90 F. When the oil from this pump reaches 20 psi, the main seal oil pump and the auxiliary seal oil pump begin operation. A pressure of 300 psi on the discharge side of the seal oil pump causes the auxiliary seal oil pump to shut down and when the proper level in the seal oil tank is reached, the unit bypass valve opens to purge and pressurize the compressor case. After a time delay of 30 seconds, the unit vent valve closes and the compressor case is fully pressurized.

Discharge valve opens when a differential pressure control senses zero differential across the unit suction valve. As the discharge valve reaches the 1-in. open position, the following are energized: the emergency shut-down controls, the alarm and shut-down annunciator system, the fuel solenoid valve and the ignition control circuit. All intelligence devices, both alarm and shut-down, and all relays have been selected to give "fail-safe" operation.

Ignition is not on until after the engine is purged and the gas is turned on. When the discharge valve reaches the full open position, a blue light on the engine and console boards announces that the pre-start sequence is complete. This light will fail to come on if any of the steps in the pre-start sequence have not been completed. When the discharge valve is 1 in. open and the alarm and shut-down circuits are energized, any fault would be indicated on the engine board and if a shut-down device operates, the shut-down procedure would be initiated and the unit will return to complete shut-down condition.

The engine is started by the operator from the gage board. After the engine begins operation, the suction valve is opened by pressing either an inching button or a full open button.

If an alarm intelligence device operates:

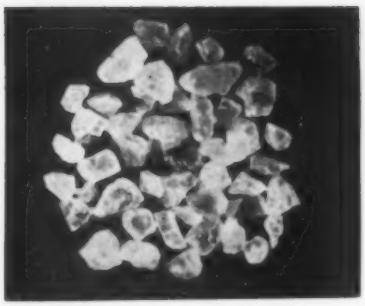
1. The red light on top of the engine board will flash;
2. an amber light on the engine annunciator panel will flash, indicating the source of intelligence;
3. the compressor unit master light on the main console will flash.

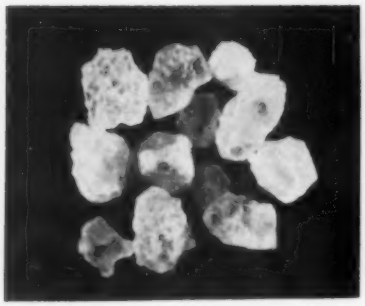
If the operator can rectify the faulty condition, the intelligence circuit will re-establish itself and automatically turn on the amber light.

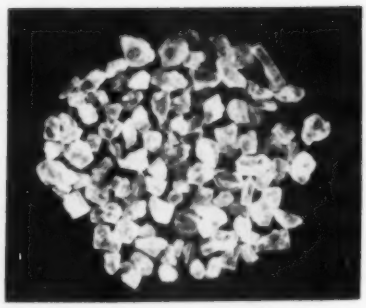
If a shut-down intelligence device operates:

1. The red light on top of the engine board will go out;
2. a red shut-down light on the engine panel will come on;
3. the unit light on the main console will go out.

Simultaneously, a continuous signal will be given by the howler and buzzer. THE END







Which Salt for Industrial

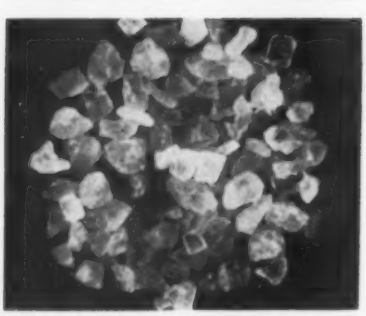


Fig. 1. Samples of Northern rock salt show (top to bottom) Northern No. 1, Northern No. 2, Northern C.C. Color is slightly darker than that of Southern rock salt. Purity ranges from 97.5 to 98.5 per cent sodium chloride

By DON HEATH *

SALT as a water treatment chemical has become increasingly important to the power plant installation, along with the greater importance that is being placed on water quality. Storage and handling of this chemical have become significant factors in planning for the modern power system, and selection of the best and most economical type and grade of salt available should be a matter of careful investigation. Description of the commonly used and acceptable types is given here as a guide to the consumer.

Rock Salt

Rock salt as a natural deposit is found and produced in many different geographical locations. There are three general source areas that may describe the purity and quality of the salt. Maps in Fig. 4 outline the distribution from these areas as permitted by economical freight costs.

From one source area to another, rock salt is obtained from the natural beds or domes by shaft mining. The salt is crushed and screened much like coal, usually at the surface level. Screen sizes shown in Figs. 1, 2 and 3 are very much the same from one deposit to another throughout the country, and quality does not depend on size of the particle. Each of the source areas produce salt that has recognizable traits that must be accounted for when using the salt in water treatment equipment. A description of these follows:

Southern Rock Salt

This kind can be said to be the better of the three rock salts. This includes salt obtained from dome-type southern rock salt deposits found in Louisiana and Texas and is distinguishable from other source-area deposits by its white and often clear crushed particle.

All rock salts contain inherent moisture within the natural crushed particle. The southern deposits are very low in inherent moisture and create slightly more dust in handling. It is important in handling this grade to use the type of equipment that creates the least abrasion or is well covered and housed.

All rock salts contain soluble and insoluble impurities. The southern grades have the least impurity level and leave an insoluble of sandy texture when dissolved. The ratio of insoluble impurity to soluble impurity is approximately 3 to 1 by weight. This varies, however, because the major impurity is comprised of calcium sulphate which upon remaining in contact with brine can become slowly soluble.

Brine produced by dissolving southern rock salt is relatively pure and clear when dissolving equipment or systems are cleaned regularly. The purity range from good quality sources is 98.5 per cent to 99.4 per cent. Brine produced from this type of rock salt is acceptable for cation exchange treatment but must be replaced with a refined salt for anion exchange water treatment due to the high content of soluble calcium sulphate. This soluble impurity may form $CaCo_3$ precipitates within the exchange unit when regenerating anion exchange material.

Northern Rock Salt

This salt is found throughout the northeast and north central sections of the country and is recognizable by a slightly darker color than southern rock salt. This color comes from the presence of natural anhydrite found in the face of the beds being mined. When this grade is crushed and screened to size the anhydrite is broken into particles of similar salt size and gives a mottled effect of light

*Staff Brine Specialist, Morton Salt Co

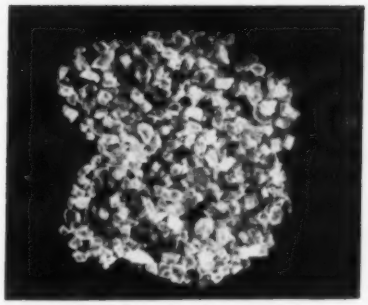


Fig. 2. Samples (left to right) show: Southern rock salt No. 1, Southern No. 2, Southern A, Southern C. Screen sizes are much the same in all deposits

Water Treatment?

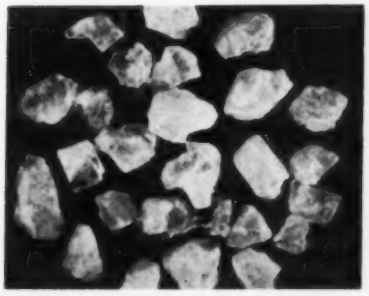
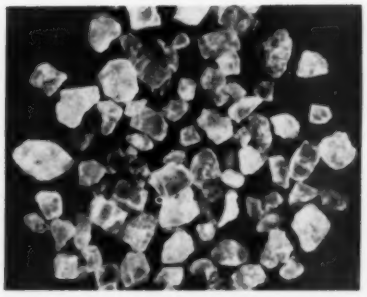


Fig. 3. Samples of (left) Kansas Coarse rock salt and Kansas Medium rock salt.



Purity range of 92 percent to 98 percent is typical of these Kansas grades

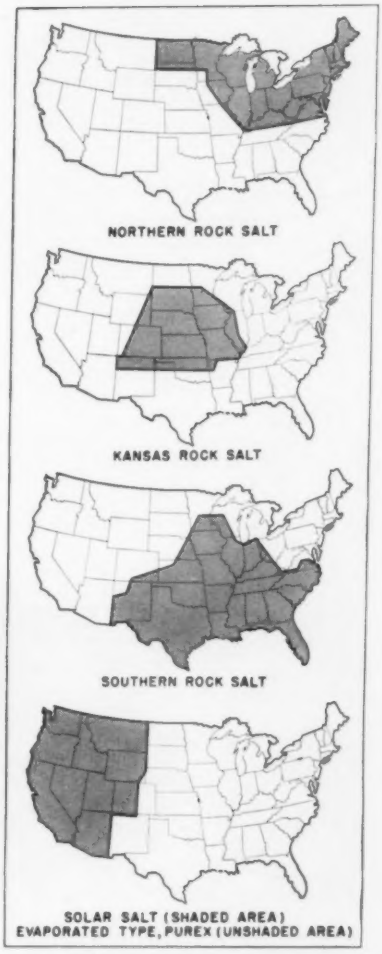


Fig. 4. These maps show distribution areas for different salts, as permitted by economical freight costs

and dark crystals through the salt.

Insolubles, formed in dissolving this salt, have a relatively fine particle size as well as larger aggregate anhydrite crystals. A brine storage tank is suggested when dissolving all grades of rock salt and is valuable in settling the finer insolubles when being pumped or ejected to the treatment unit. This affords protection to the valves and brine distributor manifolds in the treatment equipment. It is wise to establish periodic cleaning of the dissolving units, based upon consumption of salt.

Northern rock salt from good quality sources ranges in purity from 97.5 per cent to 98.5 per cent sodium chloride content. For cation exchange units adequate clarity and purity of brine from these grades are obtained when the dissolving equipment is kept clean. Anion exchange units require brine of less calcium and magnesium content than is produced by this salt.

Kansas Rock Salt

This salt is found in the west central and north central sections of the country and is very similar in appearance to northern rock salt. This salt contains considerable impurity and develops insolubles of fine particle size, requiring frequent cleaning of dissolving equipment.

Brine purity produced from frequently cleaned systems is adequate for cation exchange units, but settling tanks and low rate downflow dissolving is recommended to avoid carry-through of insolubles. A purity range of 92 per cent to 98 per cent is typical from good quality sources and the screen sizes shown are generally the same from this source area. For anion exchange a refined salt is recommended over these grades.

Refined Salt

Under this heading are those grades of salt resulting from purification methods used to obtain the salt from brine. "Evaporated salt" is the term generally applied to this salt, indicating that it is obtained by evaporating water from brine made from original solar or rock salt deposits.

Solar Salt

Solar salt is normally obtained by allowing the solar heat to evaporate water from brine ponds. Salt is formed at the base of these ponds and is harvested by raking the bed. The salt more acceptable for water treatment is later washed of surface solids with saturated brine and then dried in kilns to a consistently low moisture content. *Low moisture content* is important in selecting from this type of salt, to develop the lowest delivered cost of sodium chloride at the plant site. Water can be an expensive hidden freight and handling cost.

Shown in Fig. 5 are three grades of this type. Map in Fig. 4 defines generally the distribution as limited by delivery cost. Selection of particle size is important to handling and storage conditions. The coarser grades are adaptable to handling methods where breakage can occur, and to those storage conditions with moisture present.

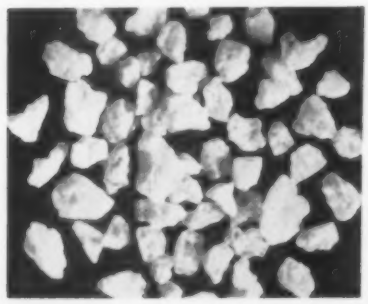
Dissolving equipment or systems that allow full immersion of the salt during brine make-up is best for the finer grades shown and equipment

that has a lower-liquid level is better suited to the coarser grades.

The brine produced from kiln-dried solar salt grades is clear, pure and non-sludge forming. Although more impure grades are obtainable in solar salt, depending upon source, it can be stated that good quality salt ranges in purity from 99.2 per cent to 99.7 per cent sodium chloride.

Evaporated Salts

"Purex" and "999" salt types are produced when water is introduced by well casing to underground beds or domes and returned as saturated brine. Brine is settled, filtered, and treated before entering vacuum-steam evaporators. Salt is formed in relatively small cubic crystals, which are further kiln dried and screened to grades. This process results in obtaining very high purity and an all-soluble salt. "Purex" and "999" types have controlled granulation to enable them to be used in dissolving systems.



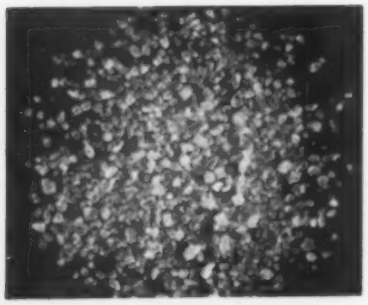


Fig. 5. Solar salt samples (top to bottom) show Extra Coarse Kiln Dried, Coarse Kiln Dried, and Medium Kiln Dried. Brine is clear and quite pure

Although there are many types of evaporated salt, it is suggested that those used be of cubic crystal structure, meeting a screen specification of not more than 15 per cent through a 65-mesh screen, and a minimum purity of 99.5 per cent sodium chloride.

In cases where the water quality in dealkalizing systems must be free of calcium and magnesium, a purity of 99.95 per cent sodium chloride is recommended. The remaining .05 per cent impurity should be a soluble and inert sodium salt.

Evaporated salts are available in many of the source areas mapped for rock salt, at comparable or slightly higher delivered prices.

Purex type of evaporated salt is available except in far western states, where solar salt compares closely in quality. The "999" type is available nationally for those systems requiring the purity. A purity range of 99.5 per cent to 99.7 per cent is considered good quality source for Purex-type evaporated salt, while "999" salt should have a purity of 99.95 per cent.

Summary

There are two basic classes of salts used in water treatment: Rock Salt and Refined Salt. Rock salt is used when conditions of delivery prevail that economically prohibit the use of refined salt.

Rock salts may be distinguished by source area, and are called: Southern rock salt, Northern rock salt, Kansas rock salt.

Refined salts may be distinguished by purity: K. D. solar, Evaporated — Purex type, Evaporated — "999" type.

In choosing the salt for water treatment the exchange method is an important consideration.

Cation exchange regeneration requires brine of, a, low suspended impurities, b, medium but nevertheless consistent purity, and c, a consistent brine strength.

Anion exchange regeneration requires brine of, a, high purity — calcium and magnesium free, b, no suspended impurities, c, consistent brine strength. Refined salt, Evaporated "999"-type, is recommended.

Other important factors to consider in choosing class and grade of salt are:

1. Impurity levels as to cost of the delivery, handling and cleaning, when comparing rock salts to the refined salt types.
2. Selection of the coarser grades for low-liquid level tanks and systems during brine make-up. The finer grades are more suited to full immersion when dissolving.
3. Use of brine storage and settling chamber when using grades of rock salt.
4. Use of coarser grades when breakage in handling may occur.
5. Use of finer grades for more rapid rate of dissolving.
6. Use of coarse grades when storage conditions are adverse. THE END

New Use for Slag and Fly Ash

MOUNTAINS of useless slag and fly ash at power plants may become miles of excellent cost-saving roads through coöperative research by the University of Illinois and the Illinois Division of Highways.

George W. Hollon, civil engineering instructor, has been studying and testing the material for more than a year. A trial section of highway shoulder was laid recently near Chicago.

Illinois power plants alone produce 1,500,000 tons of slag and fly ash a year, and some pay up to $1.25 a ton to haul it away. Hollon estimates this would make 210 miles of 24-foot road, and that five miles can be built at the cost of three miles of standard main highway.

Lime is used as the cementing agent with the slag-fly ash. Besides low cost, the mixture is said to have other advantages. It is not affected by outdoor temperature changes, an important cause of damage to present roads. It can be worked for up to 16 hours after mixing. This would eliminate mixers at the road building site. Ordinary dump trucks can haul the material from a central mixer.

Because the slag-fly ash-lime mixture wears away easily, it must be surfaced with black-top. Many present black-top roads are on a portland cement base. This is where the new material has its promise.

Hollon says its particular value is for building secondary roads, city streets, and parking lots. Several lots are to be built soon in Chicago. Portland cement remains the material of first choice for main highways.

Melvin E. Amstutz, Lake County highway superintendent, plans a section of slag-fly ash-lime black-top road to be built this spring. He is particularly interested because crushed stone for permanent construction costs $5.50 or more a ton in that area, while a million tons of slag and fly ash are available at little or no cost from just one power station dump in Waukegan.

Hollon says that waste lime, which has been used to make acetylene gas, is as good for making the mix as other lime costing twice as much. Four per cent of lime is used with 36 per cent fly ash and 60 per cent slag. The most critical item is water, which must be controlled within 1 per cent.

The mix is slower to season than portland cement, but continues to gain strength over a longer time.

The material is almost identical with that used by the Romans to build roads hundreds of years ago. Many of these still are in good shape. The Romans used lime with volcanic ash, which has chemical and physical properties almost identical with the slag and fly ash from modern power plants burning soft coal.

Before and After . . .

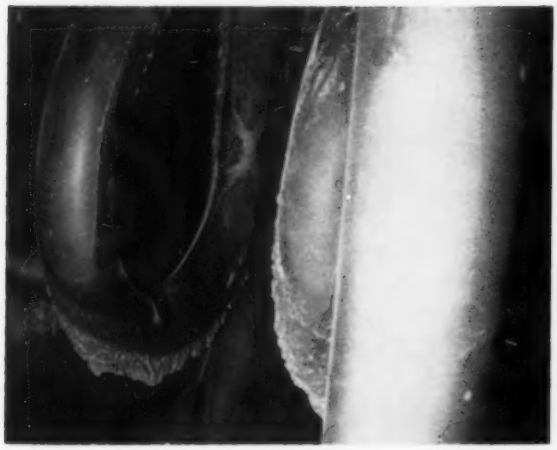


Fig. 1. Erosion on lower loop of superheater tube, after two years of operation, in a new boiler. Note actual metal wear

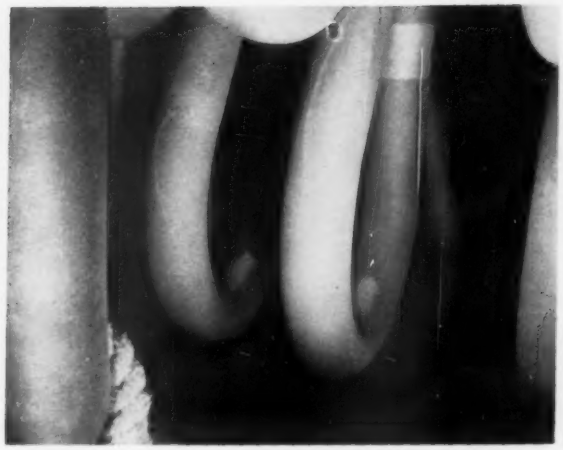


Fig. 2. Eroded arecs of tubes have been completely rebuilt, with the application of .010 inches of sprayed metal deposit

Metallizing Superheater Tubes

By ERNEST WICKLUND*

BURNING of low-grade fuels, such as lignite, creates many problems for the operators of plants using them. The high content of ash is the primary reason for most of the maintenance inside the boiler.

Our plant burns lignite, in two 230,000 lb-per-hr, 875-psi, 900-F boilers. After some months of operation, we noted an unusually heavy degree of erosion on superheater tubes. A careful study of this showed that we were getting virtually a sand-blasting effect — caused by the mixing of heavy fly ash particles with the steam from the soot-blowers.

In the initial adjustments of steam pressure to the retractable soot-blowers, we found these factors of importance: 1, if the steam velocity is too high, erosion of tubes results from the sand-blasting effect mentioned; 2, too low a pressure will not give effective tube cleaning, and the boiler must be taken out of service more frequently. Both end results are costly; however, it appears more sensible to find some method of preventing damage from soot-blower erosion.

When we found that we had a number of eroded superheater tubes in one of our boilers, we made an attempt to find some method of returning them to their original condition. Normally we would have been forced to remove the tubes entirely and install new ones. As all boiler operators know only too well, this is most expensive and time consuming. In analyzing the various maintenance methods which could normally be used to replace metal we settled on the idea of spray welding, or metallizing, of the boiler tubes. However, before we could finalize this decision it was necessary for us to check with boiler manufacturers and insurance carriers. We had to obtain information on the application of spray welding material to the boiler tubes, to see if there would be any adverse effects. The boiler manufacturer and insurance company contacted had not heard of this maintenance scheme having been tried before. Finally, we decided to take a chance and attempt repair of a number of tubes by this scheme.

Considerable preparatory work was done before we started the actual metallizing of the superheater tubes. Great pains were taken to prepare the surfaces, otherwise the entire procedure would have been a failure. The method which we employed, step by step, is as follows:

1. The boiler was taken out of service, and the entire furnace was cleaned — in the conventional manner — of all fly ash deposits.

2. The surfaces which were to be metallized were completely sand-blasted, with silica flint shot, using conventional sand-blasting equipment.

3. Tubes were metallized — to rebuild the eroded areas to original thickness.

Figure 1 shows the actual condition of the tubes, as found immediately after shutdown. Figure 2 shows the same tubes completely restored by metallizing.

The metallizing equipment was set up where it would be most convenient to the operation. The metallizing was then started immediately after the second sand-blasting. This was done to prevent any further oxidation of cleaned surface of the tubes. This is very important. A further precaution which should be exercised is that new canvas gloves should be worn by the mechanic who is to do the metallizing. The hands of the operator should not come in direct contact with the surface to be metallized.

Actual metallizing consisted of applying .010 inches of METCO No. 33 metallizing to the eroded sections. This application was applied completely around the tubes — at the eroded locations — in the belief that this method would provide the best bonding. (At a later inspection, however, it was found that complete all-around metallizing was not necessary. No flaking was evident, so it was decided to simplify future jobs by applying new metal only on the areas of actual erosion.)

Method Results in Big Savings

Estimates of replacement cost of lower superheater tube loops in our two boilers was $25,000. Opposed to this, the actual cost of material, labor and equipment use — in the metallizing work — was about $2300. This is, of course, a phenomenal savings; also, there is a shorter out-of-service time on the boilers, which has not been evaluated. This item, in itself, can be far more serious than the actual cost of the repairs. In some plants it is not even possible to take one boiler out of service during peak periods, except in cases of emergency; then, not for long. THE END

* Plant Supt., Central Power Electric Coöp

2 (Above) Close-up of large break illustrates well the varying cross-section encountered during the welding

1 (Left) Runner in inverted position before repair of larger fracture, shown in the center of the photograph

A picture story of successful emergency repairs . . .

Fractured Runner Blades Welded At Site

By LLOYD McWILLIAMS *

WHEN A 40-TON propeller-type runner dropped a short distance while turning it over, the impact broke the tip of two of the blades, one near the inlet end, and the other at the outlet end. One fracture measured about 40 in. long, the other about 14 in. The material varied in thickness from ½ in. at the edges to 2½ in. at the center.

Under-surface of the blades had previously been built up (due to cavitation) with a layer of 301 stainless steel about ⅛ in. thick. The fracture surfaces of the metal were brightly crystalline, with a course appearance. The fracture pattern indicated that the break might have been initiated in the 301 layer and progressed into the metal.

Repairs were made on the site, without sending the runner to an outside engineering shop, as was first considered.

Perfectionists in the welding trade would naturally recommend that if extensive welding be done on a piece this size, it be stress-relieved following the application of the mild steel and prior to laying any stainless. The nearest furnace that would take this large a runner was in Montreal. Using this would have meant several weeks additional outage time on a unit that was badly needed.

Following consultation with a welding engineer from the Dominion Bridge Company, Montreal, it was decided to forgo the stress-relieving. However, it was advised that some preheating be done while the welding was in progress.

As a guide, the following steps were set up to assist the men doing the welding job:

1. Prepare double vee'd groove along fracture to attain balanced welding. (See Fig. 3.)
2. Remove the stainless overlay about ¼ in. to ½ in. from the side of vee to avoid contamination of the mild steel weld which might lead to cracks and possible future failure.
3. Line up the broken segment, then use strongbacks at four points. Check alignment against undamaged blades as a reference.
4. Weld with mild steel about 4 in. of the joint at each end. This will positively locate the blade and allow a check to be made on the outside periphery of the blade. If proper dimensions are not found at this stage, the welds may be cut out and realigned without too much difficulty.
5. Weld (with low-hydrogen rod) about ½ in. deep on top side, peaning each pass lightly.
6. Back-groove (with chipper) the under side of the top weld before starting any welding on the lower side. Weld in about half of the bottom groove. Pean.
7. Alternate welds top and bottom. Finish top (pressure side of blade) full depth of vee.
8. Leave about ⅛ in. on bottom (discharge side) for stainless overlay. Lay stainless.
9. Grind both sides to desired finish.

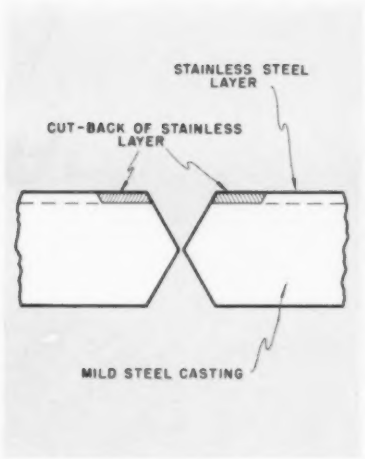
In following the guide as set up, no difficulty was experienced. However, discussion covering certain details of the job might be helpful.

Cutting Vee's. A gouging torch was used in cutting the vee's, and to burn off the stainless in the vicinity of the fracture. The edge of the weld preparation was examined with a wash of copper sulphate to determine whether all the stainless had been removed. Copper sulphate will not color stainless.

Lining Up. One-in. by one-in. pieces of stock were used to hold the broken pieces in position while being tack-welded. After the broken pieces were correctly positioned, a spreader-bar was welded between the tip of the broken segment and the sound runner blade above.

Preheating. The areas affected were first heated to approximately 400 F using coal-oil "hog-burners", from then on the required heat was maintained with an acetylene heating torch. While the welder worked, the heat was applied to the opposite side of the blade using a circular motion. Temperature readings were taken with a direct-reading contact-making electrical instrument.

* Maintenance Supervisor, Shawinigan Water and Power Co, Shawinigan Falls, Canada



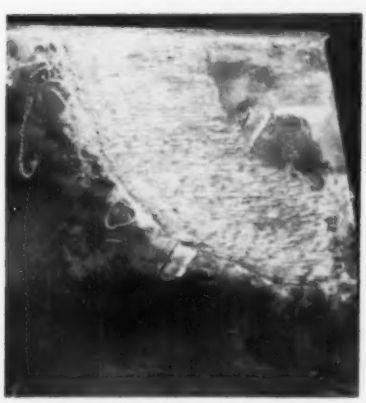
3 Sketch showing proper preparation of weld cross-section. Removal of every trace of stainless is necessary

4 Using two pieces of 1-in. by 1-in. stock tack-welded to the runner the smaller broken piece is being aligned

5 Close-up of strongbacks which were welded in staggered positions on both sides of the work after alignment

6 After preheating before welding, a torch is used on the opposite side of runner to maintain temperature at 400 F during welding. Stress-relieving was necessarily foregone

7 Welder at work on the top side of the runner blade. His left hand is on the spreader bar which has been welded between adjacent blades. A low-hydrogen rod is being used



8 Close-up of the completed welding job on the smaller break. This was later ground by hand to a smooth finish

Welding. Low-hydrogen rod was used on the main part of the welding throughout. (Care should be taken when using low-hydrogen rod to keep it away from moisture.) This is a better type of metal and has greater resistance to cracks forming when welding heavy sections.

When welding the welder alternated from top to bottom to cut down any tendency to warp. Every pass was peaned. This is very important. During the time the welders were not working, electrical heaters were placed beneath the blades which were covered with asbestos cloth. The idea was to hold the temperature and not allow the area to cool off too quickly.

Time taken to do the job was one week. The unit has now been in operation several months and is running smoothly. THE END

9 Completed welding on large break, after removing strongbacks. After grinding it was hard to locate fracture

How To Get Better Performance for Carbon Brushes

QUESTIONS ANSWERED BY G. H. GUNNOE, JR.*

What Can You Do About the Problem of Metal Transfer?

HERE IS a series of questions often asked the writer, and the answers he gives. They are reproduced from Bulletin GAE-6688, recently published by his company.

Q. Mr. Gunnoe, just exactly what do you mean by metal transfer?

A. It's metal which has been vaporized, or rubbed, from the commutator or collectors, and deposited in the brush face.

Q. What are the causes of metal transfer?

A. Basically, metal transfer to the brush face is caused by two conditions. First, by the electric arc generated between the brush and commutator; and second, the actual friction condition that exists between two rubbing surfaces.

Q. Is all metal transfer harmful?

A. No, not inherently. I would like to make it clear that metal transfer is a fundamental phenomenon that is essential for the successful operation of a carbon brush on a commutator. Actually we only worry when the rate of transfer is excessive.

Q. Why is some metal transfer essential?

A. It is the transfer of metal from the collector surface, and its oxidation, which helps form the necessary commutator film. This film lubricates the sliding action between the brush and commutator surface. Of course, this oxide film needs a certain amount of moisture to complete its lubrication function.

Q. Why is excessive transfer harmful to the machine?

A. Well, a book can be written on this question, but essentially these are the important points: excessive transfer will decrease the efficiency of the machine's operation by decreasing the commutating ability of the brush, increasing the friction of the brush, increasing the selective action of the brush, and causing abnormal wear of the commutator.

Q. Can I tell by looking at the face of a brush if the transfer is excessive?

A. Not always. Metal that is transferred becomes tarnished with an oxide coating, so that it assumes the same black appearance as the carbon. By using a special laboratory technique, the copper becomes visible to the eye. Then the shape and distribution of this copper can be studied through the microscope.

Q. Well, how can this help me?

A. I appreciate that operating personnel do not usually have the facilities for making this study. However, here are some conditions that you can observe on the commutator that indicate excessive transfer: raw streaked commutator appearance; the burning of brush shunts; excessive chatter — although this is only a part of the condition; appearance of free copper on insulated surfaces; and, in extreme cases, some metal will be visible to the eye in the face of the brush without reduction. These conditions are signals to look for other factors that are contributing to excessive transfer rate.

Fig. 1. George Gunnoe is associated with the Large Motor and Generator Department of GE

Q. Just what are some of these other factors, and what can I do about them? What can I watch out for?

A. Well, there are several things you can do. First, check the electrical adjustment of the machines, because excessive sparking accelerates transfer. Light load condition allows for build-up of copper in the brush face. Then, check atmosphere contamination. The presence of even slight chemical contamination will tremendously increase the transfer. Another thing to check is brush pressure. Make sure it is not too light. Also, it's always possible that the brush application itself may be wrong.

Q. Is it possible to tell more about the operating condition by examining the metal in the face of the brush?

A. Yes, but it takes someone fully acquainted with the various conditions to identify the situation. A person experienced in analyzing the brush face can often predict whether it is feasible to change a brush grade or to make some other changes.

How Can You Reduce Commutator Threading and Grooving?

Q. Mr. Gunnoe, what do you mean by threading and grooving?

A. Threading is the fine grooved lines that are cut on a commutator surface. It results when commutator material is transferred to the brush face and becomes work-hardened from rubbing on the commutator surface. Grooving is a mechanical condition caused by the inherent abrasive material in the carbon itself. Grooving can be eliminated by using carbon brushes that have a minimum of abrasive material in their make-up.

Q. Is threading found on all applications?

A. Threading can be found in just about all applications, sometimes for no apparent reason. For instance, it has happened that two identical machines can operate in the same motor room, under the same conditions, yet one is threading and the other is not.

Q. What are a few of the most common reasons for this trouble?

A. One of the basic causes of threading is the metal that has been trans-

* Senior Application Engineer, Carbon Products Sales, General Electric Co

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Raw Water Mixing Tank
City Water
River Water
Vent Condensers
Condensate Heater
Wash Water Recovery
Sedimentation Tank
Condensate
Condensate
Back wash
Make-up Storage
Wash Water Storage
Wash Water Storage
To Boiler No. 3
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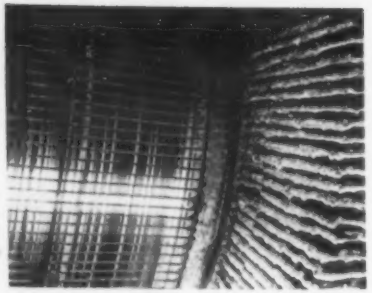

Fig. 2. Badly threaded commutator. One way to prevent this state is to remove some of the brushes

ferred to the brush face. When the copper in the brush face becomes work-hardened, it acts like a tool to cut the commutator. This is likely to occur any place where we have a condition that sets up excessive metal transfer. This could be in places of bad atmosphere, or in places of extremely clean atmosphere, yet where the machine is lightly loaded. In clean atmospheres, with light loads, the metal transfers to the face of the brush, and because of the light load, the metal is not burned or vaporized from the brush face. As a result, threading takes place when the metal has built up sufficiently. Extremely porous brush material provides good anchoring points for the copper that is transferred. This means porous carbon materials are very prone to cause threading.

Q. Then is threading a condition which arises from the type of carbon, load conditions, and atmospheric conditions?

A. That's right. It has been our experience that atmosphere and load are the greatest contributors.

Q. How do you prevent threading?

A. One way to help prevent threading is to increase the current density by removing some of the brushes. Another way is by increasing brush pressure. This means the wear of the carbon is accelerated and some of the copper in the face of the brush is removed. There have also been attempts to clean up the atmospheric condition by the use of proper filters. By minimizing the amount of contamination, we can make brushes operate on the machine without threading. Then we can vary brush materials so as to minimize the points of contact and the adherence of metal to the brush face. This can be done by treatments, by resin bonded materials, and by graphite materials. In some cases we have used fluted brushes to help control the threading condition. This brush, as you know, is the one that has the serrated flutes at 45 degree angles across the face of the brush, which increases the apparent current density and the effective brush pressure.

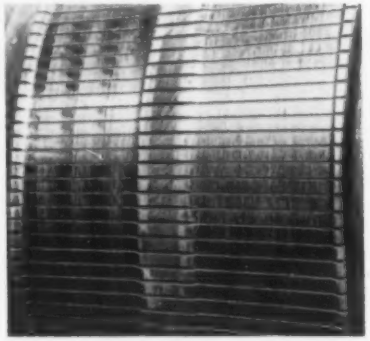

Fig. 3. Commutator grooving can be eliminated by using brushes having minimum of abrasive

Q. Are there early symptoms of threading a maintenance man should watch for?

A. Definitely! First, he must be aware of those machines which are subjected to light loads or to contaminated gases. He must learn to associate load and atmospheric variation with the conditions that develop on his machine. There may be times when strange odors can be detected, or excessive smoke noted, or long periods of light loads. It is during these periods that enough metal is transferred to cause streaking and fine lines on the commutator. If the maintenance man can recognize these symptoms then he can utilize some of the techniques that we mentioned previously to forestall serious threading. In other words, the best contribution which a maintenance man can make to prevent threading is constant vigilance.

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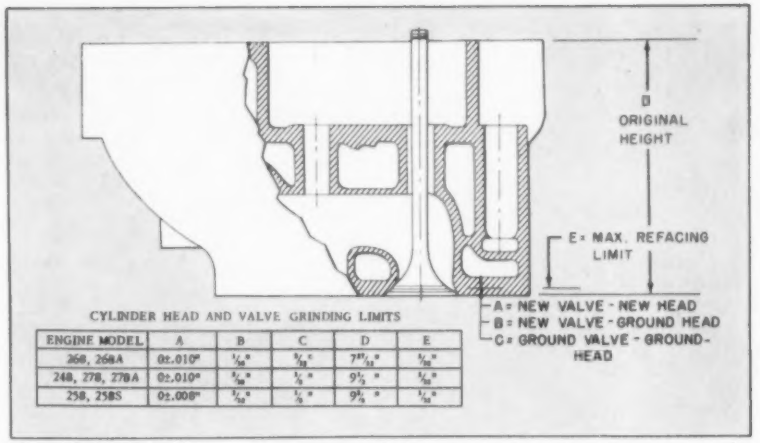

CYLINDER HEAD AND VALVE GRINDING LIMITS

ENGINE MODEL	A	B	C	D	E
268, 268A	0±.010"	1/16"	5/32"	7 27/32"	1/32"
248, 278, 278A	0±.010"	5/32"	1/8"	9 1/32"	1/32"
258, 258S	0±.008"	1/32"	1/8"	9 7/32"	1/32"

Fig. 1. Value E is the maximum which can be machined from combustion surface of head to restore it

Too Much Valve Grinding Can Ruin Diesel Heads

FIGURE 1, from the *Bureau of Ships Journal*, shows the cylinder head and valve-grinding limits which General Motors (Cleveland) recommends for diesel engines.

Value E is the maximum amount which can be machined from the combustion surface of the head to restore the head for further use. On heads machined in this manner, values B and C should be reduced by the amount removed from the machining operation.

For example, the *Journal* explains, if a model 278A head has been machined to the maximum limit (E equals 1/32-in.), the limit B should be reduced to 1/16-in., and the limit C to 3/32-in.

In connection with limits B and C, many heads are ruined by excessive grinding of the valve seats. The life of the cylinder heads can be prolonged by careful grinding of the seats. During the grinding operation, remove only the amount of metal absolutely necessary for restoring the valve seat. For additional limits, see Figs. 2 and 3.

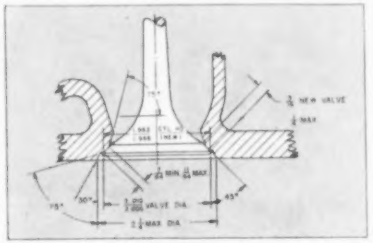

Fig. 2. Valve and seat limits, GM 268 and 268A

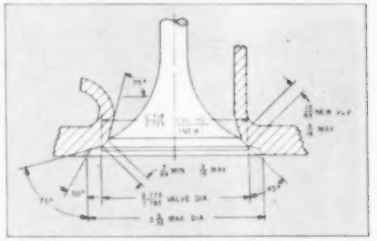

Fig. 3. Valve, seat limits, GM 248, 278, 278A

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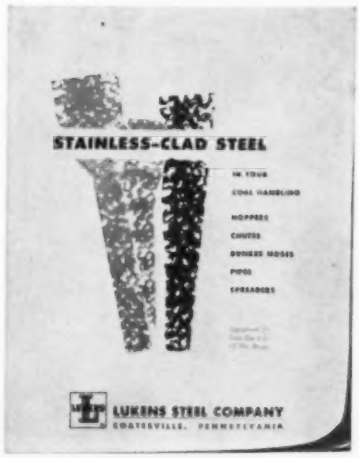

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Checking on That Generator

By E. RIGBY

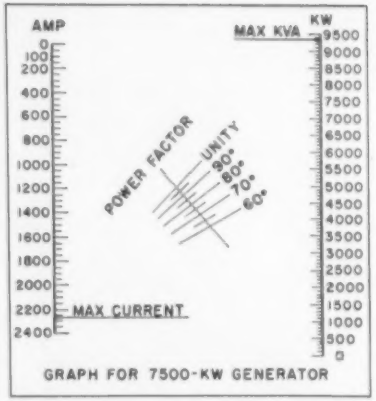
THE HOME-MADE graph shown here can be of help to small generating stations which do not have complete instrumentation and want to check on load characteristics, or want to check on accuracy of instruments without having to get into a maze of mathematics.

To make the graph, choose a size large enough so there will be sufficient space between the lines to read the scale easily when using a straight edge or ruler across the lines — especially the scale in the center, indicating power factor. A figure 12 by 14 in. would be about minimum size for easy reference.

Divide the left-hand scale into equal spaces starting with zero at the top and working down. Mark the divisions in amp, as shown, up to the full current rating of the generator.

Mark off the right-hand scale in kw, starting with zero at the bottom and ending at the top with the maximum rating of the generator at unity power factor.

Now draw in the power factor scale as a portion of the diagonal from 0 amp to 0 kw. Mark off unity pf from full current rating and maximum kw capacity by drawing a short line on the pf scale. Subsequent divisions may be drawn by using the standard formula:



GRAPH FOR 7500-KW GENERATOR

To determine amp, kw, or pf, just place straight edge over any two scales and read third scale

$$\frac{V \times A \times pf \times 1.73}{1000} = kw$$

Once you have drawn the graph there is no need for constant calculations to determine amp, kw, or pf. Just place a straight edge over any two scales and read the third quickly and easily.

Tests Show Better Metallurgy Helps Silence Manhole Covers

By C. W. STEVENS

ONE OF THE most irritating items on the list of utility distribution maintenance problems is the clatter of wobbly manhole covers. Round steam and electric manhole covers are of the larger cast-iron types. The wobble occurs after the installation has been carefully made. Some months later come the complaints.

The wobble is difficult to correct. Many methods have been used to remove the warpage by means of rotation of the cover on its seat in the manhole roof casting (see POWER ENGINEERING, June 1956, p. 104), bituminastic cushioning materials under the cover edges, grinding out the warp, and other means. These do not generally bring permanent relief, take considerable work and time, and create the hazard of blocked traffic.

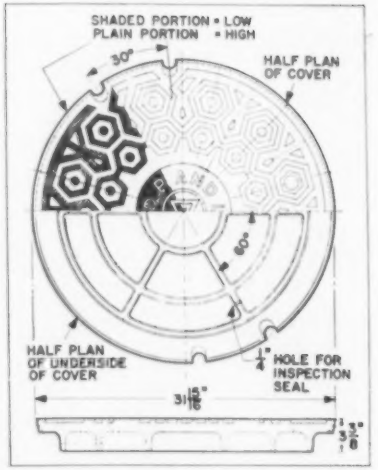
It is common knowledge that many gray iron castings gather distortion during their first six months of aging. This is especially possible when one surface of the castings has been machined and some of the chilled hard surface removed from one side, leaving the softer core metal unsupported. The strain on the hard side then pulls for readjustment of its crystals, and warpage results. Keeping the castings in the foundry yards for six months or so allows the hard carbide crystals to realign themselves within the ferrite matrix of the iron and obtain relief from these chill strains with time, as a natural process. Then machining and other operations can be performed without much fear of distortion.

Many foundries have installed large strain-relieving ovens to quick-age their green castings, heating them for about 8 hours at around 1100 F. This heating time greatly accelerates the period required for realignment of the structure, by softening the chilled shrunk layers to where readjustment can relieve the strains and stresses usually concentrated on the surfaces of the castings. These aged castings would not then warp if some of the surface layers are removed by machining.

Better metallurgy, or greater care in the selection of the composition of the iron, is a simpler solution, and a sound one. This approach was tried out in the case of electric underground 32-in. round manhole covers. The problem was handed to a capable foundry in consultation with their metallurgists. A few sets of cast frames and covers were installed at a busy downtown intersection for a four-year test.

Laboratory tests revealed that the frame castings were harder than the covers. Analyses of the metal of the covers showed it to be high-test iron comparable to No. 35 class of cast iron of ASTM Designation A-48. Chemical analysis showed its chemical content to be: silicon, 1.25 to 1.35 per cent; total carbon 3.20 to 3.40 per cent; sulphur 0.10 per cent. Its expected tensile strength was equivalent to 34,000 to 40,000 psi.

At two-year intervals the three test covers were brought into the machine shop and mounted on the bed plate of a vertical boring mill. Careful measurements were made of any distortions that occurred. Deep punch marks had been made on each test cover at six equidistant points around the supporting perimeter, just inside the machined bottom or underside of the outer 1-in. rim where the cover rests on the ring of the frame. (See the plan of underside of cover as shown in the figure.) The six punch marks were placed half way between the ribs in the center of each sector.



Plan of 32-in. cast iron manhole covers used in 4-year test for resistance to warpage. Heavy circular and radial ribs cast into underside help counteract warping forces that may develop

After four years of service in the heaviest traffic of the city, the tests showed that the warp in the three covers increased, in their maximum measurements in any direction, 0.018, 0.015 and 0.011 in.* It was concluded that the metallic iron of these covers seemed stable and under no great strain after machining and delivery.

Manhole castings cannot be treated as a lowly product for they perform a rugged service.

The design of the covers deserves attention, too, along with the metallurgy of production. It was our belief that the heavy circular and radial supporting ribs cast into the underside of the covers (see figure) provided both strength and rigidity to carry the loads better and resist whatever warping forces might develop. But the principal credit for our solution of the problem is attributed to better metallurgy.

* A table showing in detail the results of test examination of the manhole covers after two and four years' service is available to any reader, on request to The Editor, POWER ENGINEERING

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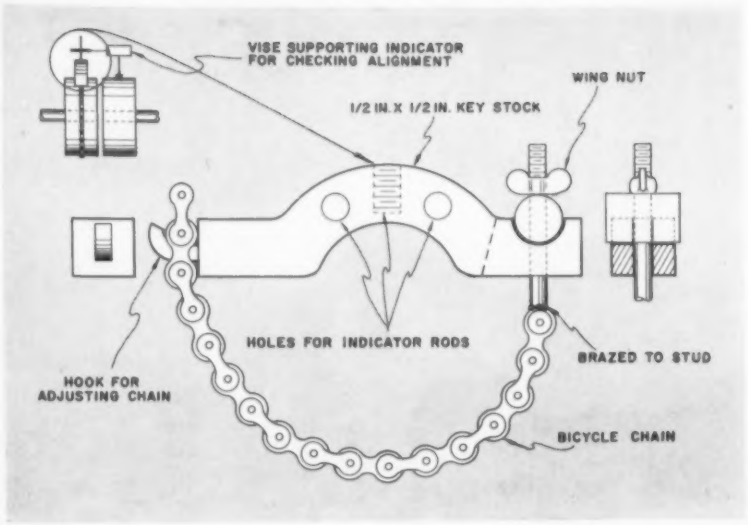
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HOLES FOR INDICATOR RODS
BRAZED TO STUD
HOOK FOR ADJUSTING CHAIN
BICYCLE CHAIN

When Checking Shaft Alignment . . .

By E. L. FAUTH

WE'VE FOUND this chain vise to be a very useful device for supporting an indicator to coupling when checking shaft alignment.

The vise shown can be used in very close quarters and on any size of shaft or coupling, the size being determined by the length of the chain.

Making Conical Turning Easier

By F. E. RILEY

TURNING of extensive conical surfaces in the engine lathe can be very laborious when using the compound slide with its hand crank.

Illustrated in the sketch is a method of power feeding the tool across an extensive conical surface, by using the cross slide feed. The method is crude, but is capable of producing good work under the right conditions.

The compound slide is set to the angle required on the face of the work. A roller is brought to bear on the side of the compound slide rest and is mounted in an adjustable arm which is bolted to the lathe bed slides.

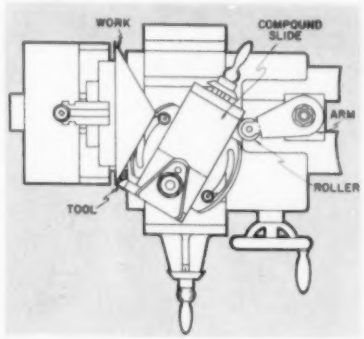
When the cross slide is traversed inward under the action of its power feed, the cutting pressure forces the tool towards the tailstock end of the lathe, carrying with it the complete carriage assembly. This sliding action is halted by the side of the compound slide rest coming into contact with the roller. Continued feeding of the slide rest will keep the roller and compound slide in contact with one another and an angular face will be produced on the work, the angle being equal in value to that which the compound slide center line makes with that of the cross slide.

Accuracy of the result depends on the condition of the lathe. For example, if the side of the compound slide in contact with the roller is an unmachined casting, then the irregularities of the casting surface will be reproduced on the conical work surface. This might be overcome by removing the compound slide rest and machining the side straight, with a light skimming cut in a shaper.

The protractor scale for setting the compound slide swivel can be utilized for setting the angle required on the work, but this will only hold good if the side of the compound slide in contact with the roller is parallel with the slide center line.

However, since the angle of the work should be checked with a good protractor, the compound slide graduations can be utilized merely as a rough guide for setting the angle.

To ensure positive contact between roller and slide, the cutting tool should be ground approximately to the shape shown. Since the cutting tool is expected to push the carriage assembly towards the tailstock, some trouble may be encountered on lathes with stiff slides or those with heavy carriage assemblies. Some positive pressure to keep roller and slide in contact with one another can be provided by the simple expedient of wrapping a rope around the carriage crank handle and suspending a weight on the end of this.

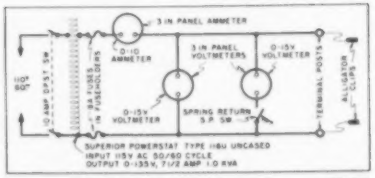


Here's a method of power feeding the tool across an extensive conical surface by using the cross slide feed. Accuracy depends on condition of lathe

fold along this line—outside edges toward you

Impedance Tester for Stator Windings

BY B. CORRADI



Impedance tester is wired like this and put in case

ONE OF THE most important tests to determine the condition of a polyphase stator winding is its impedance test. This is simply a measurement of inductive reactance obtained by reading the current through and voltage across the winding applied at adjacent motor lead terminals.

Experienced maintenance men use this test in preference to a simple d-c resistance measurement, because it will reveal any shorted turns in the winding which cannot be detected by the ohmmeter method.

The tester consists of components wired up as shown in the figure, and installed in a case. Note the spring return S.P. switch in the 0-15-v range voltmeter for safety precaution against meter burn-out when operating with higher voltages.

Whether the stator winding is wye or delta connected, the tester leads are connected between adjacent motor lead terminals, with the power line of 110 v a-c supplying the tester. The powerstat is adjusted to give any readable value of current up to 7 amp. The voltage is then read on either voltmeter, depending on the size of the motor. Identical readings should be obtained between all terminal motor leads with powerstat left at the first setting.

It must be remembered that there will be a difference in impedance values on the same motor, depending on whether the rotor is in position or removed, as during a motor overhaul. The value of the impedance with motor assembled is more desirable for future use as reference and should be recorded.

cut along this line

Oil-fired units are equipped with a Kewanee pressure atomizing burner for No. 1 or No. 2 oil. Firing rate is matched to boiler capacity. Burner and controls are shipped in separate, protective cartons, ready for wiring. Insulated metal jacket shown is optional.

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15 lb steam or 30 lb water
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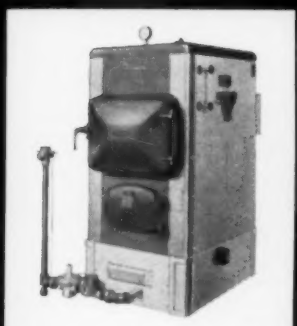

Gas-fired units feature Kewanee's atmospheric type drilled port gas burner for natural, mixed, manufactured or L.P. gases. Firing is automatic . . . matched to boiler capacity. Burner and controls are shipped in separate, protective cartons . . . installation is easy.

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CONSTRUCTION NEWS

Nenana, Alaska — Golden Valley Electric Assn, Fairbanks, Alaska, has plans under consideration for a new coal-fired generating station at this location. Detailed plans are expected to be announced shortly. Cost reported over $6,000,000. North Pacific Consultants, Inc and G. E. Wieland are the consulting engineers on the proposed project.

Helena, Ark. — Arkansas Power & Light Co, Simmons National Bldg, Pine Bluff, Ark., has announced preliminary plans for the construction of a 350,000-kw steam-electric generating plant on a site located on the Mississippi River, near here. Construction of the new steam-electric generating station will begin later this year for completion in 1961. When in operation, it will form a part of the interconnected grid system of the Middle South Utilities Co, operating in three states. Total power available from company's steam plants will be increased more than one third when new plant is completed at a reported cost of $56,000,000

Pittsburg, Calif. — Pacific Gas & Electric Co has ordered a 300,000-kw, 3600-rpm turbine-generator unit from Westinghouse Electric Corp. It will boost by almost 50 per cent the capacity of the PG&E's Pittsburg, Calif., power plant. The turbine generator will go into service in 1960. It will operate at 2400 psi, 1050 F. The unit will be installed outdoors. Installation of this turbine generator is part of an expansion program to double the Pittsburg power plant's capacity, authorized last year by PG&E's Board of Directors. On completion of this program, Pittsburg will be one of the few power plants in America with a total capacity topping 1,000,000 kw. Its present capacity is 660,000 kw.

Alton, Ill. — Administration Board of Saint Anthony's Hospital plans addition of five-story wing to present hospital facilities to provide for an additional 72 beds. New wing will be of reinforced concrete and steel frame construction, with provisions to house large new boiler plant, laundry and food facilities. Work when completed early in 1959 will cost approximately $1,641,000.

South Bend, Ind. — Indiana & Michigan Electric Co, 220 W Colfax Ave, has announced approval from the Indiana Public Service Commission for financing in the amount of $25,000,000 through the sale of bond issue, proceeds of which will be used for new generating station which company plans to build on the Wabash River in Sullivan County, south of Fairbanks. New installation will have an initial capacity of 150,000 kw and will cost approximately $38,000,000 when completed late in 1960.

Baltimore, Md. — Baltimore Gas & Electric Co, Lexington Bldg, has arranged a construction program of more than $250,000,000 over the next five-year period. Company has budgeted $45,000,000 for new construction in 1958, $15,000,000 of which is earmarked for new power generating capacity. Work is currently under way on the installation of a 125,000-kw steam-electric generating unit at company's Herbert A. Wagner power plant scheduled for completion in mid 1959.

Braintree, Mass. — Town of East Braintree, Municipal Light Board, 44 Allen St, Braintree, Mass., plans expansion in municipal power plant, including installation of additional equipment, and improvements in present station facilities. A new G-E turbine generator will be installed with an initial capacity of 12,500, at a reported cost approximating $775,000. Work will get under way at once for completion by the spring of 1959.

Holyoke, Mass. — City, Gas & Electric Dept, 70 Suffolk St, has preliminary plans under way for expansion of city's municipal power plant, with installation of new steam generating unit with a capacity of 160,000 lb of steam per hr. Work will get under way at once for completion by early 1959. P. J. Kennedy & Co will be in charge of construction.

Minneapolis, Minn. — Northern States Power Co, Minnesota, has authorized an expenditure of more than $54,000,000, for construction and new facilities through 1958. Largest allocation of the budget is an amount of $20,000,000 for the St. Paul Division with half of the amount going toward construction of a new 156,000-kw installation there. The Minneapolis Division will receive $10,000,000 for system expansion and improvement and another $9,000,000 will go toward system expansion to the Northern States Power Co, of Wisconsin.

St. Paul, Minn. — Northern States Power Co, 15 S Fifth St, Minneapolis, Minn., has plans under way for major addition to company's High Bridge power plant with the installation of a sixth generating unit. Installation will include a 150,000-kw turbine generator unit, high pressure boilers and auxiliary equipment. Cost estimated in excess of $24,000,000, including cost of building to house new facility, transmission lines, power substations, and other operating facilities. Work is already under way and unit is expected to be placed in line by early 1959.

Billings, Mont. — Carter Oil Co, 2813 Third Ave, North, has announced plans for increased capacity at local refinery here. Work will include renewal of existing equipment with major additions to boiler and furnace facilities to boost company's total capacity from present 25,000 bbl per day to approximately 34,000 bbl daily. Work is expected to get under way at once. Cost reported to be about $1,500,000.

Omaha, Neb. — Omaha Public Power District, 17th and Harvey Sts, has awarded contract in the amount of $357,600, to the Henry W. Miller Electric Co for all work and material for complete wiring of No. 3 unit, now being installed at local power station, including station, screenhouse, substation and yard facilities. Company has also contracted with General Electric Co, for construction of new substation at Jones St Power Station. Cost of this installation with auxiliary equipment reported to be just under $1,000,000.

New York, N. Y. — Consolidated Edison Co of New York, Inc, 4 Irving Pl, will spend a record $200,000,000, on new construction through 1958. Over the next five-year period, 1958 through 1962, company has budgeted a total of $800,000,000, for construction, 90 per cent of the total to be spent on company's electric system, including installation of 1,275,000 kw of new power generating capacity. All generating additions are presently under construction or authorized as previously reported in these columns, including the 275,000-kw Nuclear Power Plant at Indian Point, New York. This station alone will represent an investment of more than $100,000,000 when completed in 1961.

Poughkeepsie, N. Y. — Central Hudson Gas & Electric Corp has arranged for increased generating capacity at company's Danskammer Point Power Station near Newburgh, N. Y. New installation, a steam-electric generating unit, fourth such installation at this plant, will have an initial capacity of 138,000 kw and will increase station's total capacity when completed in 1963 to approximately 416,000 kw. Third unit, currently being installed for completion in late 1959, will increase station output to 278,000 kw. General Electric Co will furnish the turbine generators and Combustion Engineering, Inc, the boilers. Cost reported about $25,000,000.

Sandusky, Ohio — National Advisory Committee for Aeronautics, Lewis Flight Propulsion Laboratory, Cleveland, Ohio, has applied to the AEC for permission to construct a 60,000-kw reactor at Plum Brook Ordnance Works near here. Construction plans are reported to involve an expenditure of approximately $10,735,000.

Pittsburgh, Penna. — Aluminum Co of America, 1200 Alcoa Bldg, has announced final agreement with the government of Surinam, formerly Dutch Guiana, to proceed with a joint $150,000,000, hydroelectric and aluminum smelter project in that country. Alcoa will build a dam, hydroelectric power house and transmission lines to provide an initial capacity of 150,000 kw under the program. Construction will begin in 1960 for completion in 1965. Second phase of the project calls for construction of an aluminum smelter with a capacity of 60,000 tons annually. Eventual construction of a bauxite refinery using local deposits of aluminum is also under consideration for the future.

San Antonio, Tex. — City Public Service Board of the City of San Antonio has authorized plans for the expenditure of approximately $1,400,000, on expansion and additions to municipal power plant here. Work will include electric transformer installations, overhead electric power line installations and additions and improvements of power generating equipment at Villita St Power Plant, for increased generating capacity.

Stamford, Tex. — West Texas Utilities Co, 1062 N Third St, Abilene, Texas, has plans under way for the installation of a large steam turbine unit at company's Lake Stamford power plant here. Cost reported in excess of $1,500,000. Company also plans to expend approximately $11,500,000 for high voltage transmission lines connecting power plants and load centers, and another $15,000,000 for construction and improvement of company's power and distribution facilities in the Abilene area. All work under way is part of a five-year major expansion program of company's facilities.

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EQUIPMENT NEWS

Reader Service Cards on pages 141–142 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

1—BOILER requires less than a third of usual space

The Thermodyne is announced as an automatic heating and steam boiler requiring much less space than most boilers of equal power. Company engineers call it a water-tube type boiler engineered around a "vertical bent-tube" concept, in which the vertical arrangement of the tubes provides exceptionally rapid water circulation and high heat transfer resulting in 80 per cent thermal efficiency. The bent-tube concept has also permitted design of a new blow-down system for rapid removal of collected waste solids.

Other design features cited include a burner that is easily removable and

interchangeable for gas or oil, and chest-high assembly inspection enabled by the simple removal of a panel, with each tube easily replaced. Thermodyne units built for electricity are designed to heat the boiler to maximum output faster. The shop assembled Thermodyne has five assemblies: steam drum, tube section, frame, and inner and outer panels. For outdoor or indoor use, there are 14 variations of three basic units, ranging from 5 to 1000 hp. Hercules Power Equipment Co.

2—SWIVEL JOINTS for higher pressures and temperatures

The Series 750 Type S Swivel Joints for steam pressures to 750 psi and temperatures to 750 F are used to provide pivot points in pipe hook-ups to make the piping movable or flexible. Stock sizes are 1 and 1¼ in., with screwed or welding ends. To provide strength for the higher pressures, casing and retainer flange are steel, the ball is hardened steel, and the spring is stainless steel. Typical applications are on high temperature steam piping connected to moving machine or equipment parts.

The gasket incorporated in the joint is made of high density carbon with a relatively low coefficient of friction, and is lapped to the ball. Movement between ball and gasket provides a constant relapping which automatically adjusts for wear, it is noted, and the gasket is installed under compression to prevent leakage. Barco Mfg. Co.

3—INSULATING CEMENT gives more coverage, is whiter

Improved Super Powerhouse Cement is a white insulating-finishing cement said to provide 30 per cent more dry coverage with virtually no shrinkage. Field tests are reported to show that 100 lb of it will cover an area 72 sq ft, ½ in. thick. Also, this new quick-setting cement is said to dry even whiter than its predecessor and give a harder finish with reduced density. According to company these improvements have been attained at no sacrifice of qualities of the former product and with no increase in cost.

The cement both insulates and finishes in a single coat whether applied directly to such irregular hot surfaces as valves and fittings or over other insulations. Gray when applied, it dries to a glazed white surface when finish trowelled. Due to its negligible shrinkage, it is reported particularly suitable for use on large areas. The cement remains workable for 1 hr and sets to initial hardness within 3 hr. Manufacturer says it will withstand drenching rain after taking its initial set and can be painted, if desired, while wet or dry. Baldwin-Hill Co.

4—FAULT LOCATER pinpoints defective cable insulation

The Thumper is used to pinpoint — within a few feet — defective insulation determined through high potential testing of electric power cables, or faults developed in service. According to company, this fault locating is achieved regardless of length of cable by conversion of high voltage, low current output of a d-c high potting instrument into a high voltage, high current impulse supply.

A sphere gap is adjustable from the outside of the unit so the breakdown voltage may be varied to suit the fault of the cable being tested. Test potential and repetition rate of the pulse voltage may be varied to suit conditions. Exact location of the fault may often be determined by moving along the cable and listening for point at which the tracer signal breaks across the fault. The Thumper is rated at 25 kv, manufacturer notes, and the great available energy permits high instantaneous peak currents which result in a loud discharge, even though the fault is some distance from the test point. The instrument is designed for use as an accessory with any d-c high voltage breakdown tester or power supply, it is announced. Associated Research, Inc.

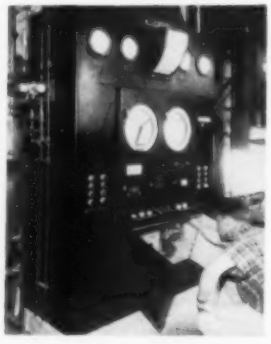
5—ELECTRONIC UNIT records output from four wires

This electronic recorder is designed to receive and record output from up to four remote ring balance meter-operated slide wires. It can be used to record any quantity measured by company's ring balance meter, including fluid density, liquid level in open or closed vessels, boiler drum water levels, and temperature and pressure compensated fluid flow readings. Heart of the recorder is an electronic receiver, a compact unit housing an amplifier, input box, servomotor and slide wire. Up to four receivers can be installed in a single recorder. Accessory combinations, including a pneumatic transmitter for control system signals, slide wire output for logging systems, alarm contacts and computing devices can be used with the receiver. Available as an a-c bridge, d-c potentiometer or d-c voltmeter, the receiver converts incoming electrical signals into corresponding pen positions for recorder and indicator. This same motion drives the integrator. Hagan Chemicals & Controls, Inc.

6—COMBUSTION CONTROL in 10 standardized systems

Ten separate and distinct standardized systems of electric combustion control for varying boiler requirements are announced. The "package" consists of a fully piped and wired free-standing panel containing all instrumentation and control necessary for automatic operation of single burner gas and/or oil fired boilers, either packaged type or field assembled design.

A feature of the packaged control is the placement of the manual-automatic control stations required for operation of the system. These switches, together



with indication lights and push buttons, are on a small console, 33 in. from the floor. Both convenience and safer operation are enhanced by this arrangement. The electrical components cabinet is immediately beneath the console and contains the automatic programming control, fan starter, relays and terminal strips, all accessible from the

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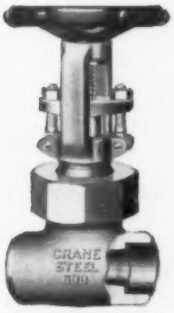

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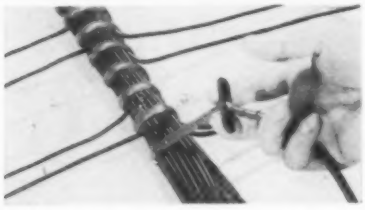
front panel. Field of application for these control systems is from small 6000 lb/hr packaged steam generator to large 100,000 lb/hr boilers, single burner fired. Publication 57-1088-239 gives details. The Hays Corp.

7—RECONDITIONING PROCESS guards against rust, fires

Jenolizing is said to make mechanical equipment look like new, to protect it against rust, and reduce the risk of fires. The process is reported to open new practical applications for steam cleaning. Two new developments of company's Hypressure Jenny steam cleaner division are important to the process. The first is a cleaning compound, known as AP, which is claimed harmless to paint, wiring, or aluminum and magnesium surfaces. Second is a protective coating, Protect-O-Gloss, applied while the steam cleaned surfaces are still warm and wet. It serves to prevent rust and leave a glossy, like-new finish. For plants already having a Hypressure Jenny, a Jenolizing kit is available. Homestead Valve Mfg. Co.

8—WIRING TOOL simplifies electrical cable harnessing

The Cable-Former is a simple tool designed for use with company's Wiring Tube, a spirally-cut, non-flammable polyethylene cable lacing. The Cable-Former is a small plastic blank with a center slot approximating the cross



section of the flexible Wiring Tube. In use, it is threaded over one end of the tube, then wound around the bunched wires to form a neat, compact cable. As the tool is moved along the length of the wire, it "unwinds" the tightly formed spiral tube and wraps it over the wires with uniform pressure to make a flexible, yet secure free-running cable. The tool is now supplied with the Wiring Tube at no extra cost. Panduit Co.

10—CHECK VALVES for oil or raw water service

These 4000-psi spring loaded check valves feature an inverted seat design and are said to be self-cleaning. According to manufacturer, downward flow through the seat rings and past the check located below it keeps the sealing surfaces free of foreign particles that might cause leaks. Flow area through the valve is claimed equal to or greater than the transverse area of nominal size extra heavy pipe. Available in sizes from ½ to 2 in. NPT, these valves are reputed to afford excellent resistance to corrosion. Valve body and seat retainer are Navy M bronze; seat, stem and guide are stainless steel, and spring is Inconel. Stem and seat are replaced by removing the seat retainer. O-rings seal retainer and seat. Sinclair-Collins Valve Co.

11—OUTDOOR MOTOR with improved protection, ventilation

Available from 250 hp and up, this weather-protected motor is designed to exceed the new NEMA Type II definition. According to company, the equipment meets a need for an improved ambient-breathing motor which can be installed indoors or out, offer necessary weather protection and still have a pleasing appearance. Requiring up to 33 per cent less floor space than previous models, its cube-like shape allows quick cleaning and discourages dirt accumulation on frame. The frame contains no vents. Air enters louvered side openings in the top section and is exhausted from end louvers. With this arrangement, motors may be mounted side-by-side or close to other equipment, without interfering with ventilation. Top louvered intakes and exhaust serve to prevent animals, weeds etc. from entering.

Utilizing labyrinth-like passages for ventilation, the system provides for straight blow-through of air in the event of high-velocity winds. Both intake and exhaust portions of ventilating system incorporate this feature to eliminate pressure build-ups during severe storms. Among features contributing to ease of maintenance are easily-removable filters, and endshield and air deflector design permitting a 300-deg inspection of windings and easy inspection of bearings, and a split bearing design permitting sleeve bearings to be rolled out, checked, and replaced without disturbing alignment. General Electric Co.

12—THERMOMETER for use in limited space areas

Model G Thermometer has a head diameter of 1 11/16 in. and is suited for use on equipment where space is limited. The instrument is built on company's direct-drive principle. Of stainless steel (except for the aluminum and black crystal-protected dial) it is moisture sealed, overheat and pressure protected and individually calibrated. Model G Thermometers come in 11 ranges from 0 to 200 F to 200 to 1000 F, and from −10 to 110 C to 0 to 300 C. Stem lengths can be supplied from 2½ to 72 in. W. C. Dillon & Co., Inc.

13—MECHANICAL SEAL uses magnetic force for sealing

This simple seal has just two working parts held together by magnetic force. This force retains an even pressure on the optically flat sealing surfaces regardless of operational pressures, says

manufacturer, and a seal is formed between self-lubricating carbon and Alnico metal lapped faces so tight that helium gas cannot leak through. The magnetic seals can be used to replace many conventional packings or mechanical seals in pumps, compressors or on rotary shafts where liquids, gasses or corrosives are to be sealed. Because of their compactness, they are claimed to fit any stuffing box, and are readily installed on any smooth shaft without use of set-screws. A. W. Chesterton Co.

14—5-KV INSULATOR is offered in new material

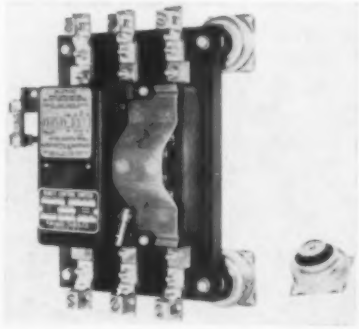
Made of glass-reinforced polyester, this 5-kv standoff insulator introduces a new material in standard insulators for higher voltages. Glastic insulators cost less and weigh less than porcelain ones, says manufacturer, yet they have greater dimensional accuracy, higher impact strength, and outstanding resistance to arc erosion and thermal shock from high current power flash over. Weight of a Glastic 5-kv Standoff Insulator is given as 1.3 lb and dimensional accuracy is reported to be such as to eliminate need for shimming and hand fit-up. It is announced as meeting all NEMA Class A-20 physical and electrical specifications. The Glastic Corp.

15—CHEMICAL PACKINGS coded for service identification

Three styles of this color-coded mechanical packing for chemical service cover the full pH scale. For sealing strongest acids (pH 1 to 4) manufacturer offers Blu-Lon, a blue packing, in which each blue asbestos fiber is multicoated before and after braiding with a concentrate of Teflon. It has also undergone a heat

9—REMOTE CONTROL SWITCH designed to work quietly

Equipped with vibration mounts and in soundproof enclosures, these remote control switches are announced for installation in locations where quiet operation is essential. Reductions in operating noise level are claimed considerable, as compared with similar switches without vibration mounts and soundproof enclosures. Tests are reported to show that operating noises of the latter switches were audible at a distance of 250 ft, while operating noise of these new switches was only faintly audible at 3 ft. The switches are used to provide any convenient and accessible control of power and lighting circuits from any number of central stations. Manufacturer notes that since they are mechanically held, they are unaffected



by line voltage conditions and respond only to pushbuttons. Details are in Publication 627. Automatic Switch Co.

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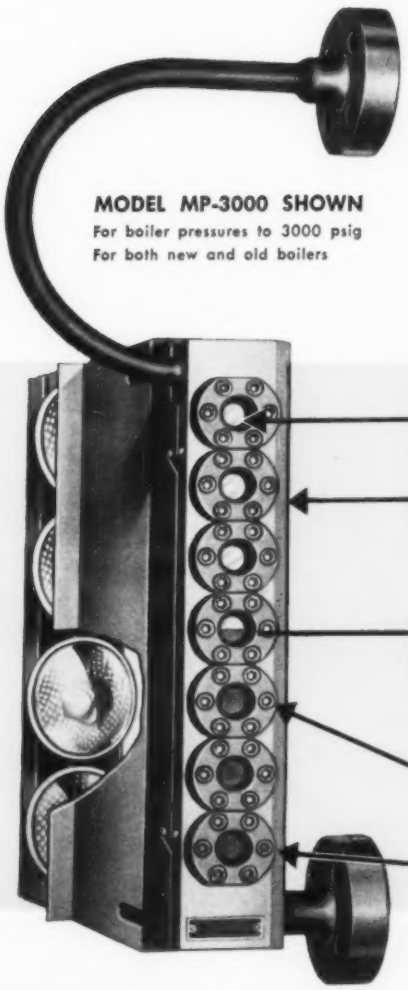

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For both new and old boilers

SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS

GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE

STEAM SHOWS RED
WATER SHOWS GREEN

Also available is Model MP-900 for boiler pressures to 900 psig

COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES

EACH PORT THERMALLY INDEPENDENT

Because the Diamond Multi-Port solves the problems inherent in water level gauges on boilers operating at high temperatures and pressures, it has had rapid and wide acceptance. In addition to the 2000 for central station generating plants, more than 185 have been sold to industrial power plants.

Advantages of the Multi-Port are many. In addition to those shown above, it has maximum thermal stability for rapid starting . . . "Hi-Lite" illuminator for improved readability . . . welded construction for permanent tightness . . . end stems can be furnished instead of flanges . . . startling reductions in maintenance costs.

Write for Bulletin 1174 (Model MP-3000) or Bulletin 2044 (Model MP-900) for more information.

8032

Diamond

DIAMOND POWER SPECIALTY CORP.

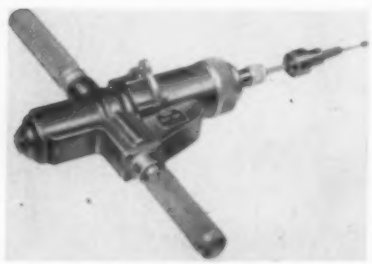
LANCASTER, OHIO • DIAMOND SPECIALTY LIMITED — *Windsor, Ontario*

For more data circle 552 on Post Card

controlled process to assure retention of Teflon and immunize it against harsh acids, it is noted. For sealing mild acids and mild alkalies (pH 5 to 7) Style 315, a black graphited braided asbestos packing is offered. For sealing strong caustics and other alkalies (pH 8 to 14) there is a white packing, White-Lon, which has received a multicoat of Teflon over asbestos fibers before and after braiding. A fourth packing, Super-Lon, is brown color coded and designed for use over the entire pH scale from sulfuric acid to sodium hydroxide. It is woven of Teflon. A. W. Chesterton Co.

16—TUBE EXPANSION CONTROL offers speed and accuracy

This pneumatically operated tube expansion control is designed to automatically control tube expansion by accurate measurement of torque, rolling up to 12 tubes a minute to uniform accuracy. Claimed accurate to within 0.001 in., the control stops expansion



according to a predetermined setting. This results in uniformly tight joints with no over expansion or under expansion, company states, the accuracy obtained through the torque sensing mechanism which is unaffected by fluctuations in air pressure.

A finger-tip micrometer adjustment is set to desired torque without using any tool, and the calibrated ring permits setting as low as 0.5 ft-lb and up to 37 ft-lb torque at 90 psi. Three models are available for tube sizes from $\frac{1}{4}$ to $1\frac{1}{2}$ in. OD. All three models may be used in rolling both steel and non-ferrous tubes. Airetool Mfg. Co.

17—WATER COOLERS for closed system applications

Designed for closed system applications where process water temperatures are critical, these units are claimed to save up to 95 per cent of the water normally used for industrial cooling. The line includes three styles: centrifugal fan draw-through units, suggested for indoor installation where floor space is a factor; centrifugal fan blow-through units, featuring dry fan operation for longer life; and propeller fan blow-through units for use where minimum horsepower is desired. Applications include cooling water for diesel or gas engines, air compressors, plastic molds, and other water jacketed equipment. Baltimore Aircoil Co., Inc.

18—FIRST AID STATION for plant-wide use

Small enough to mount close to hazardous areas, yet large enough to hold necessary first aid items, this cabinet is reported especially useful where immediate first aid treatment must be given to prevent serious organic injury. Each of the cabinet's doors has a positive action catch that cannot open as a result of nearby vibration, manufacturer announces, and other safety features are rounded-corner construction, one-piece doors and platform base. The cabinet is 66 in. high, 24 in. wide and 12 in. deep, it weighs about 52 lb and is finished in white enamel. General Scientific Equipment Co.

19—FILTER-HOSE UNIT delivers filtered air

Filtered fresh air for ventilating tanks, vats, drums and other areas available from a portable, self-contained source known as Filtairvent. The unit employs a positive pressure impeller to deliver a rated 560 cfm of air through a 20-ft length of 8-in. diam synthetic fabric hose. Contained within the hose is a 6-ft high efficiency flame-proof filter, of sufficient area to permit operation for a year or more in average dusty conditions with negligible loading. It may be removed and shaken to restore suction as required. For portability and storage the filter-hose combination can be wadded down into compact size. When used as a man-cooler, it is detachable as a single element by means of a quick-acting latch fastener. The trunion mounted cylinder may be rotated through a 120-deg arc to direct air stream up or down. A switch mounted on the enclosure is connected with a plug-in cord and with the 110 v single phase $\frac{1}{3}$-hp motor. Dustender Co.

20—POWER MEGAPHONE runs on flashlight batteries

Powered by ordinary flashlight batteries, the transistorized Power Voice Megaphone is announced as having an effective range up to $\frac{3}{4}$ mile. Its water-resistant construction makes it suitable in all weather for activities requiring extra voice power. Designed for highest audio output per pound, the unit weighs but 8 lb, yet provides 15-w amplification of thunder-like power. In use, the Power Voice is ordinarily held to the mouth and activated by pressing the trigger on its pistol grip handle. For longer periods of operation, it can be slung from the shoulder and used with

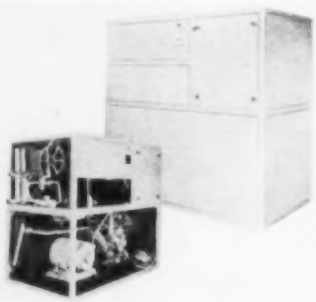
its detachable microphone. There's even a threaded hole on the bottom of the pistol grip for mounting on a tripod. Accessories provide operational versatility including units for two-speaker P.A. systems. Because of the low drain characteristics of the six-transistor amplifier, the flashlight cells supplying primary power last four months, company states, depending on frequency and extent of use. Communications and Electronics Div., Motorola, Inc.

21—CLEAN OUT DOORS designed to stand higher pressures

This clean out door, of asbestos-packed cast iron, is similar to manufacturer's former model, except that instead of having a single crossbar, hinge and handwheel arrangement, it has double cross bar with double hand wheels. Hinging is on either side to prevent any right or left in doors. The double locking device serves to prevent any leakage of outside atmosphere. The door can be insulated on the inside and also provided with locking device so they cannot close or be locked from the outside only, as the inside locking device would protect a man inside in the event someone tried to lock the door on the outside. The door can be had in six sizes from 12-by-18 to 36-by-36 in. Connery Construction Co.

22—PACKAGED AIR CONDITIONER is self-contained unit

The CPU, a pre-engineered central station air conditioning system, is completely self-contained, housing an evaporator, compressor, evaporative con-



denser, fans, motors, refrigerant piping, and controls in a grey enamel casing. All components are enclosed. A summer-winter conditioner, the CPU unit also functions as an evaporative condenser water saver. It is available in five sizes from 10 to 40 tons. Dunham-Bush, Inc.

23—CHANGEOVER THERMOSTAT for heating, cooling units

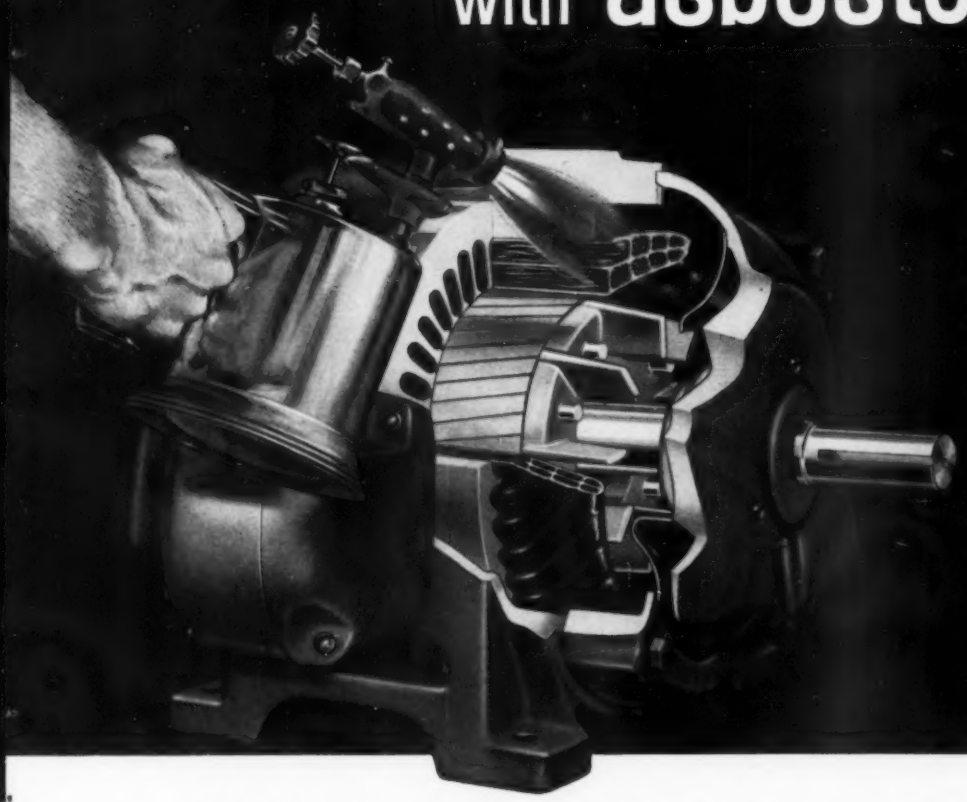
For use on combination heating and cooling air conditioning units, this summer-winter changeover thermostat is designed to sense the temperature of the supply media and reverse the control action of the room thermostat sensing element to comply with the flow of either hot or chilled water. It also has applications in process control. Its switch action is single-pole, double-throw snap-acting. It has a non-adjustable control point setting at 70 F and a fixed differential of approximately 15 F. Barber-Colman Co.

24—LIQUID RING PUMP for transfer service applications

Light weight, quick self-priming action and the ability to handle air alone, liquid alone, or a combination of air and liquid provide maximum utility for the Fig. 2520 Pump, manufacturer announces. It is available with motor for

only **U. S. MOTORS**

insulates all windings with asbestos!



your best protection

against motor burn-out and production shutdowns

Only U.S. offers this protection! ALL windings insulated with asbestos—nature's million-year-old insulating material that *cannot carbonize!* Many motor makers use varnished paper, cloth, oiled linen, press-board, fish-board—even insulating varnish alone. All these will carbonize... not one is fire-proof!

Only the original, patented U.S. ASBESTIC PROCESS—gives you: 1—*Heat resistance*... can't carbonize, 2—*heat conductance* better than any cellulose material, 3—*moisture resistance*... due to exceptional impregnation and coating of windings.

Protect yourself against costly production shutdowns due to motor burn-out! Be sure to specify: "U.S. MOTORS"!

U.S. ELECTRICAL MOTORS INC.

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FREE COLOR-ILLUSTRATED BROCHURES
For specific data on asbestos protection, write for General and Type H Uniclosed Bulletins.

For more data circle 553 on Post Card

When TUBE MAINTENANCE is the problem . . .

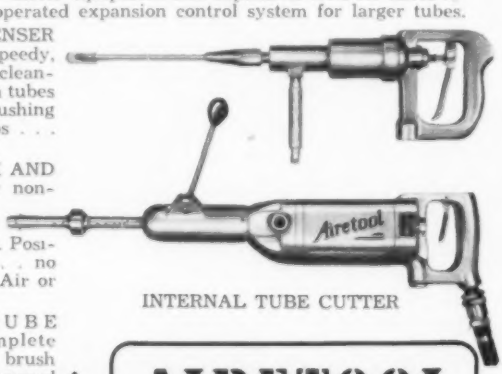
AIRETOOL has the answer

Air-powered tools for solving the toughest tube maintenance problems efficiently and economically.

FASTER TUBE ROLLING with the new Airetrol Tube Expansion Control. Just set dial and torque sensing cam automatically stops expansion to .001" accuracy. Air-motor equipment and expansion tools for tubes ¼" to 1½". Electrically operated expansion control system for larger tubes.

EFFECTIVE CONDENSER TUBE CLEANER Speedy, lightweight tool for cleaning hardest scale from tubes up to 1". Built-in flushing system removes chips . . . keeps drill cool.

CUT TUBES QUICK AND EASY Cuts steel or non-ferrous tubes through tube sheets up to 4" thick. Positive feed control . . . no gouging or burning. Air or electric motor.



INTERNAL TUBE CUTTER

POWERFUL TUBE CLEANERS A complete line of cleaners and brush heads for straight or curved tube maintenance.

Write for literature on any Airetool equipment or contact your Airetool representative for assistance on tube cleaning problems.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

REPRESENTATIVES in principal cities of U.S.A., Canada, Mexico, South America, England, Puerto Rico, Italy, Japan, Hawaii.
EUROPEAN PLANT: Vlaardingen, The Netherlands
CANADIAN PLANT: 37 Spalding Drive, Brantford, Ontario

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge.

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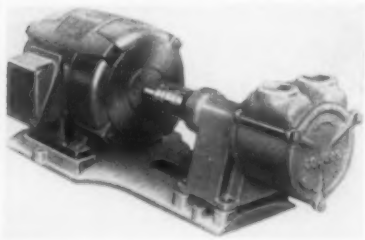
permanent installations or mounted on heavy duty casters for portable utility use. It may also be had for use with



V-belt drive. Centripetal action of the liquid ring pump directs liquid toward the center to provide the rapid priming necessary for transfer or similar applications. Access to the interior is possible through casing cover without disturbing pipe connections. Suction and discharge are 1½ in. The pump comes in cast iron or AISI 316 stainless steel. Goulds Pumps, Inc.

25—OUTDOOR MOTORS protected against rough weather

These weather protected motors come in 250- to 1500-hp ratings and are claimed to provide reliable service in high winds, driving rain, snow, sleet and sandstorms. According to manufacturer, the ventilation system prevents entrance of wind-borne particles and moisture by forcing the incoming airstream through a number of abrupt changes in direction and sharp decreases in velocity. Standard features include

split sleeve bearings and bearing brackets that allow on-the-job removal or inspection; moisture and chemical resistant insulation; low temperature space heaters to minimize condensation during shutdown periods; inspection ports for observing oil rings while motor is operating. Optional features include a pressure lubrication system, air filters for highly contaminated installations. Bulletin 2550 describes motors in detail. The Louis Allis Co.

26—GEAR REDUCER is shaft mounted, compact unit

According to manufacturer, this shaft mounted gear reducer provides a space-saving power transmission unit for many applications; it eliminates alignment problems, and it makes possible infinite speed ratios through use of variable speed pulleys or by changing sheaves, sprockets or prime mover speed. Belt tension between drive and driven unit is maintained by adjust-

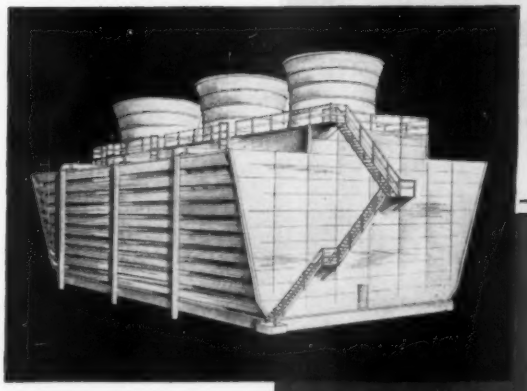
New Class 600

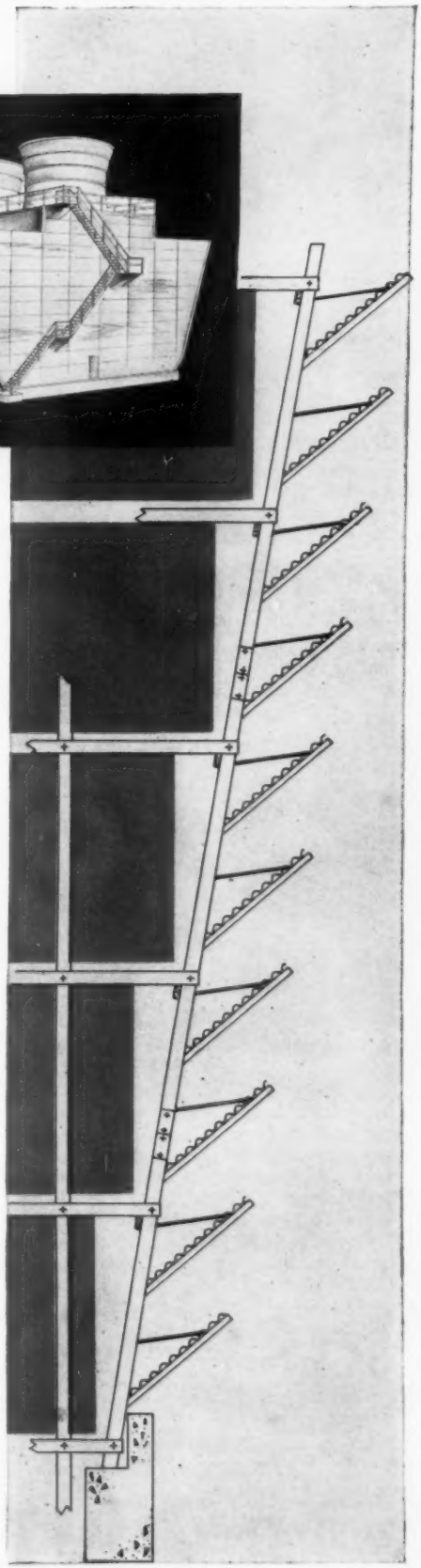
MARLEY

Double-Flow

has the

Profile with a Purpose





Comprised of a combination of "active" angles, the contour of Class 600 cooling towers is completely functional with positive influence on performance and operation. Each angle has its specific purpose and, in conjunction with the others, creates additional advantages.

Louver Angle: The 42-inch louvers are positioned on 3-foot centers at an angle of 40° from horizontal. This arrangement readily admits more air to do more cooling—with inherent lowering of static drop, higher working velocities in the fill become completely practical. It increases the atmospheric performance potential (always greatest in cross-flow towers) and it eliminates splash-out.

Structural Angle: The 10° angle outlined by the louver posts is of equal importance. It makes possible uniform fill width or uniform *air travel* at all levels in the cooling chamber. Result: more performance per cubic foot of structure gained through efficient air utilization.

Fill Angle: With a uniform fill-to-louver distance maintained at every fill story, Class 600 Double-Flows set up an effective barrier against icing. The normal *water travel* creates a continuous curtain of water between fill and louvers without splash-out. There are no non-functional voids so the heat of the water prevents formation of sheet ice and blocking of air entrance.

MARLEY

The Marley Company

Kansas City, Missouri

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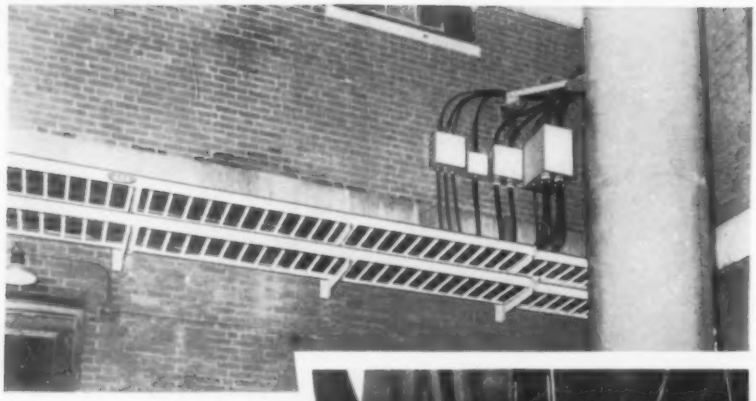
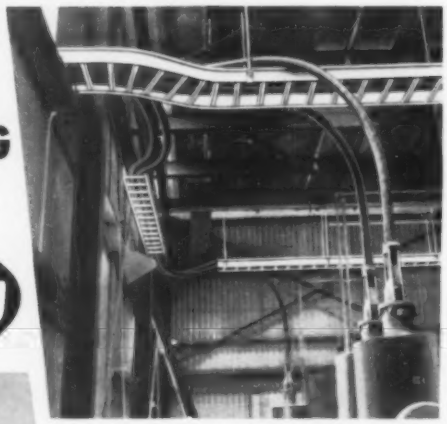
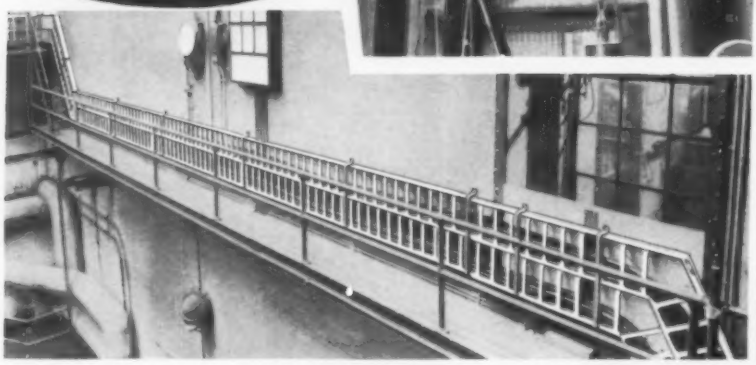




a new, superior system of
CABLE and TUBING RACE WAYS...

Globetray
PAT. PENDING



A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.

Comes in 6", 12", 18" and 24" widths, in standard 12' lengths to further speed up installation time. Cable way can be cut to length at any point—insides and bottom always smooth—all sections punched for easy installation—perfect fit at all times. Neat, clean and uniform in appearance.

Globetray
THE GLOBE COMPANY

EASY TO INSTALL • SAVES TIME • SAVES ON MATERIAL
GALVANIZED • NO MAINTENANCE PROBLEM

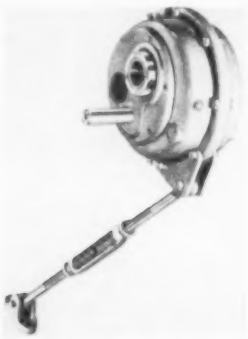
106

Write for new complete catalog. Distributors in all principal cities. Contact the Grip-Strut distributor under "Conduits" in the classified telephone directory.

PRODUCTS DIVISION The GLOBE Company
4022 S. PRINCETON AVE. • CHICAGO 9, ILL.

For more data circle 556 on Post Card

ment of rod and turnbuckle. Eighteen models, including single and double reduction types, can be had. Single reduction types afford 4.5:1 speed ratio (nominal), and double reduction types,



14.7:1 speed ratio (nominal). Horsepowers range from fractional to 120, output speeds from 8 to 425 rpm. The reducer is installed direct to driven shaft and can be mounted vertically or at angle. Lovejoy Flexible Coupling Co.

Described on these pages are new and improved products. Use Reader Service Cards on pages 141–142 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

27—PORTABLE LIFT-STAND speeds power cable installation

With the Reelift, two men can set up full reels of 500,000 or 750,000 cmc, ready to pull in minutes, it is announced. According to manufacturer, the port-

able Reelift provides a safe, rigid base for fast cable pay-out and can be readily adjusted to handle reels up to 48-in. diam, with damaged or broken reels presenting no problem. The lift-stand is of welded, heavy-duty construction with industrial enamel finish. It measures 3-by-2 ft at base. Hykon Mfg. Co.

28—HEAT FANS for high temperature application

Dura-Temp Heat Fans feature a design which utilizes a new principle for keeping the bearings in cooler operating

Huge track-mounted stacker, designed to discharge over a 165° radius, takes coal from breakerhouse to 1,800,000 ton capacity storage area. Boom is 138' in length and uses a 60" wide belt.

One of the world's largest coal handling systems

Detroit-Edison's mammoth coal handling system at their River Rouge Power Plant is one of the world's largest in the field of coal utilization for electric power. This giant is another outstanding STEPHENS-ADAMSON achievement in a long fifty-seven year record of successful conveyor engineering.

Completely automatic, the system brings coal from self-unloading ships into power plant bunkers, or puts it out to storage at 2500 T.P.H. Coal flow is electronically controlled from a central panel. Despite its tremendous capacity, STEPHENS-ADAMSON has designed the installation for a 100 per cent expansion to meet future power requirements.

If you are interested in the complete mechanical story of the Detroit-Edison coal handling system, write for an illustrated brochure, or call the S-A engineer in your area. His services are at your disposal.

The Detroit-Edison coal handling system consists of approximately 2500' of conveyors. It also includes stackers, trippers, crushers, REDLER conveyors, feeders and Zipper bunker seals.

Self-unloading ship, equipped with an S-A conveyor system, deposits coal into a dock hopper. Coal moves from this point to the powerhouse or to storage over a 60" wide belt conveyor.

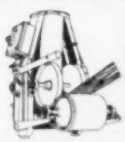
STEPHENS-ADAMSON

THE BIG NAME IN BULK MATERIAL HANDLING EQUIPMENT

BELT CONVEYOR

REDLER CONVEYORS, ELEVATORS

KNITTEL CRUSHERS



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MAIN OFFICE AND PLANT
86 RIDGEWAY AVENUE
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PLANTS LOCATED IN: LOS ANGELES, CALIF. CLARKSDALE, MISS. • BELLEVILLE, ONTARIO

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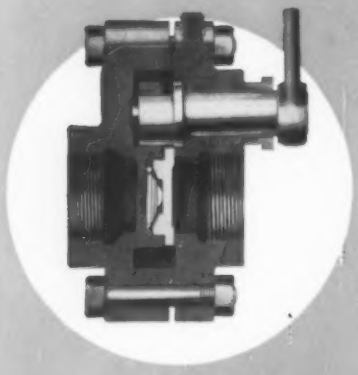
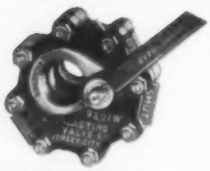
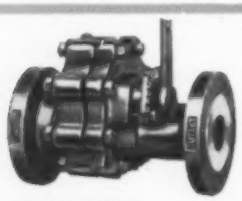
Everlasting Valves

are superior for many services





BOILER BLOW-OFF
Quick acting, also handwheel operated "Y" and angle types. For pressures up to 600 psi.



GENERAL SERVICE
Where drop-tight seal and full flow is essential.

CYLINDER OPERATED
Can be remotely controlled, electrically or manually.

STEAM JACKETED
Assures free flow of viscous materials.

WEIGHT-OPERATED
For automatic drains or emergency shut off.

When you want

- quick action
- drop-tight seal
- minimum pressure drop
- straight-through full flow
- self-grinding rotating disc
- valves that cannot wedge or jam

then you want an Everlasting Valve

No other valve has all the Everlasting features . . . proven by half a century of service to assure dependable, leak-tight service.

LET US HELP YOU WITH YOUR VALVE PROBLEMS

EVERLASTING Valves

EVERLASTING VALVE COMPANY
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EV303

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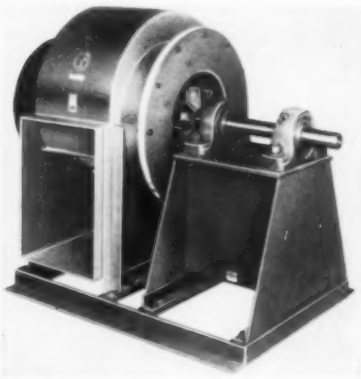
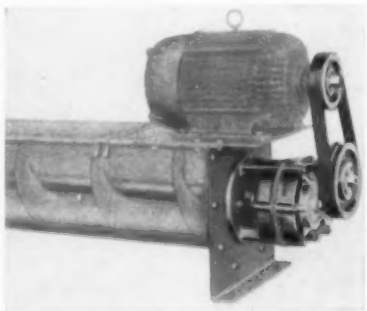
zones, preventing high temperatures inside the fan from reaching bearings and causing bearing trouble. A rotating



member of dissimilar alloy, fitted to the shaft, radiates and circulates ambient heat away from the bearing areas. The Dura-Temp Heat Fan line runs from 600 to 30,000 cfm and will handle temperatures ranging up to 1650 F. Bulletin HF 100 gives details. General Blower Co.

29—CONVEYOR DRIVE has new design features

Announced as simple to mount and adjust on standard conveyor troughs, this screw conveyor drive consists of a speed reducer with packing gland and driving shaft, which mounts on the trough end. Trough ends also are offered in sizes to fit most standard conveyors. Timken bearing are used throughout the drive to produce ample thrust and radial capacity. The drive is designed to afford utmost protection for the speed reducer unit against invasion by the material being handled by the conveyor. The packing gland is adjustable from the outside, takes standard packing



and may be inspected by sight. It is pointed out that any material that might work through the packing would fall to the floor instead of forcing its way into the reducer. A flinger seal on the shaft also serves to prevent foreign matter out of reducer seals, and another barrier against contamination is provided by double lip reducer seals.

Simplicity and economy are achieved through elimination of a sliding motor base. Instead, slotted holes in the flange of the reducer let the unit be rotated for adjustment of the V-belt drive center distance. Both motor and drive may be mounted in any position. The screw conveyor drives come in four sizes and each size comes in two ratios: 18 to 1 and 8 to 1. Dodge Mfg. Corp.

HAGAN RING BALANCE FEATURES—NO. 5

wide range AUTOMATIC COMPENSATION for PRESSURE-TEMPERATURE variations

In any metering application where true level or flow cannot be inferred from differential alone, because of variations in fluid density, the Hagan Ring Balance meter can be compensated for these variations.

A simple, integral linkage computes the correction factor from temperature, pressure, density or a combination of these and applies the correction automatically. The accuracy of this correction is maintained over a wide operating range by the geometry of the linkage.

The Ring Balance compensated meter gives all the information necessary for a quick, visual check of the computation it is performing. Both the corrected and uncorrected values as well as all variables are displayed either as records or indications.

With fifteen years of pioneering in the practical application of precise metering, such difficult measurements as drum level in high pressure boilers, pre-heated air flow, delivery of blowers and exhausters, and extraction steam flow, Hagan engineers have the experience and background to help you solve either routine or unusual metering problems.

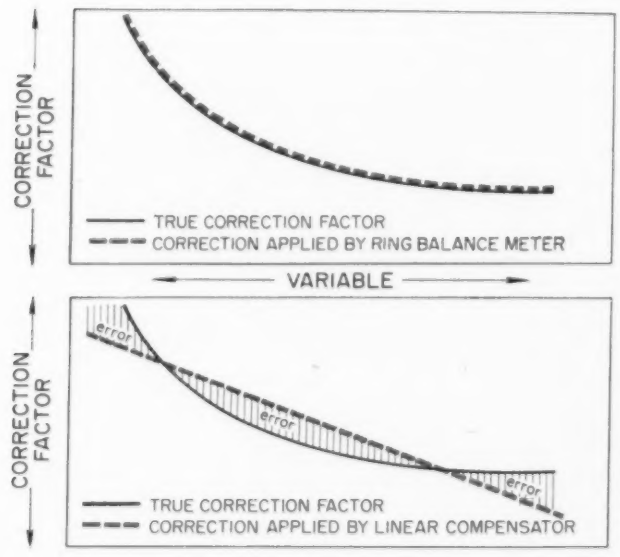
Ask your Hagan engineer to explain these other Ring Balance features:

1. Ease of calibration under operating static pressures with factory calibrated check weights! No more four-story water columns and telephones!
2. Safe operation with rings rated at 2,500, 6,000, 15,000 psig. No gaskets, no stuffing boxes.
3. Sealing fluid density and level not critical. No eye-droppers required.
4. Interchangeable ring assemblies for full scale ranges from 0.5" w.c. to 560" w.c. Adjustment on any one ring over a 7:1 differential range.
5. High sensitivity at low flows due to unique range calibration system.
6. Pneumatic or electric transmission also available. Any Ring Balance meter can be equipped with slide-wire for operation with data-logging devices and for transmission to the Hagan PowrLog.

For additional information, write for Bulletin MSP 147.

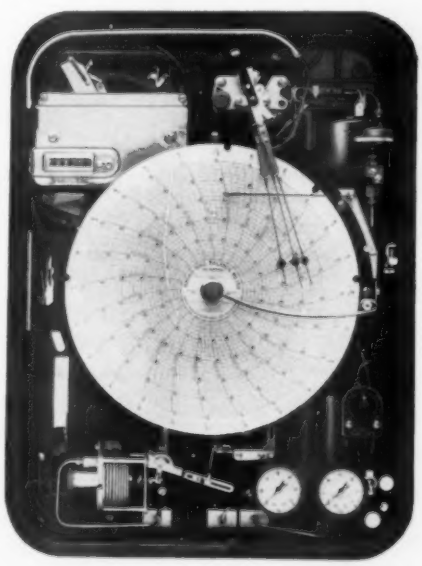
HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO



Wide range compensation is made possible in the Hagan Ring Balance meter by the unique curvilinear motion generator. The compensation applied is correct throughout its entire range because it is characterized to fit the true correction curve at all points—see top diagram.

Other methods of compensation, which utilize straight-line correction, conform to the true correction curve at only two points, producing error in the compensation as shown in the bottom diagram.



Compensated Hagan Ring Balance meter with door removed. The three pens record uncorrected flow, corrected flow and pressure. Corrected flow can be integrated and transmitted for remote recording or control purposes.

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The fabrication of sheet steel and plate to exacting specifications has been a specialty of Kirk & Blum for 50 years. Exceptional experience and complete facilities for fabricating carbon steel, stainless, aluminum, monel and other alloys up to ½" thickness.

Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication Booklet.

Whatever your requirements in sheet and plate fabrication . . . call on KIRK & BLUM.

THE KIRK & BLUM MFG. CO.
3230 Forrer Street, Cincinnati 9, Ohio

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Central Fuel Committee

continued from page 83

no "average" coal buyer understands them all. No single utility trafficman knows them all; no single purchasing agent can know them all.

Between rail, river, lake, ocean, truck, pipeline, conveyor and other means of moving coal, only widespread groups of plants have contact with more than a few of these methods. Rates and regulations are intricate, yet they are all interrelated. Over the years, transport competition has evolved a system of rates that meet situations that have arisen in various areas, at different times.

Each coal buyer meets his problems as they arise; usually alone. Transportation groups, such as the railroads, are coördinated into associations that see the broad picture. Many factors are not visible to the younger buyer, such as: common switching areas, multiple-siding access, variable routing, and substitute — or alternate — means of transport. These advantages only show up in times of stress — strikes, delays, car difficulties, etc, along with car demurrage and service.

This author has heard of complaints from coal producers, against the purchasing policies of the two greatest users of coal: the public, and private, power producing entities — government and privately-owned users of coal. Both of these great groups have been blamed for many of the producers' problems. Table VI shows the demands of TVA and AEC; plus the utilities using over 100,000 tons annually — for the five year period starting 1955. In 1955, the public plants used 24.6 per cent, and the larger utility plants 74.1 per cent of the total power-generating coal. In 1959 these figures become 30 per cent and 68.9 per cent, respectively.

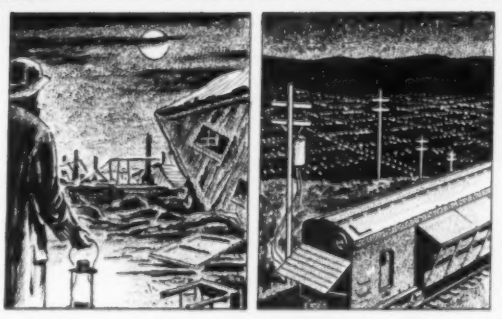
One answer might be that the coal producers, including the miners (independent of their producing, marketing and labor associations), still act individually to meet buyers on the other side of the table. The many plants of the privately-owned utilities have no common policies or practices, insofar as fuel purchasing is concerned. While most utilities delegate the function of fuel-procurement to their purchasing departments, as coal buyers, some place this responsibility within their power production divisions — as fuel engineers.

This author was a *utility fuel engineer*, buying coal. He solved the problems of price, transportation, quality, adjustments, complaints, and requests for assistance — single handedly. His transportation involved rail, river and truck movement of coal. He tried to use his coal piles as a mobile storage, as proposed in Item 4. From all such years of actual experience he feels qualified to recommend a Central Fuel Committee for EEI. THE END

POWER POINTERS

Rocket hot or Cold as upper air

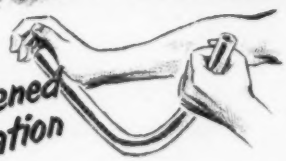
AT THE LOW TEMPERATURES OF HIGH ALTITUDES (BELOW-100°F.) ORDINARY STEELS ARE TOO BRITTLE TO USE. AT ROCKET ENGINE TEMPERATURES THEY'RE AS WEAK AS TAFFY. BUT HIGH NICKEL ALLOYS ARE DIFFERENT. INCONEL NICKEL-CHROMIUM ALLOY GETS EVEN STRONGER AND STAYS TOUGH AT SUB-ZERO TEMPERATURES. AND IF YOU TURN ON THE HEAT IT KEEPS USEFUL STRENGTH EVEN UP TO 2000°F.



"Blackout" to "lights on"

...in 12 hours mobile emergency unit delivers 12 times the power of first public utility

12 HOURS AFTER MOVING INTO A DISASTER AREA, THIS GAS TURBINE PLANT ON WHEELS DELIVERS 6,500 KW—OVER 12 TIMES THE POWER OF THOMAS EDISON'S ORIGINAL PEARL STREET STATION. TRANSITION SECTION OF UNIT'S GAS TURBINE, WHICH CHANNELS 1350°F GASES TO BLADES, IS INCONEL* NICKEL-CHROMIUM ALLOY. INCONEL ALLOY RESISTS CORROSION, OXIDATION, LOSS OF STRENGTH AT HIGH TEMPERATURES.



How the tube that couldn't be straightened started instrumentation

TRYING TO STRAIGHTEN A TUBE, INVENTOR BOURDON, CLOSED ONE END AND INJECTED HIGH PRESSURE STEAM. TUBE STRAIGHTENED ... BUT SNAPPED BACK WHEN STEAM WAS GONE! THUS WAS BORN THE BOURDON GAUGE... AND MODERN POWER INSTRUMENTATION. TODAY, MANUFACTURERS MAKE MANY HIGH PRESSURE BOURDON GAUGE TUBES OF "K" MONEL*. THIS NICKEL-COPPER ALLOY IS EASY TO FABRICATE, TAKES PRESSURES UP TO 100,000 PSI, HAS MINIMUM HYSTERESIS.

Having trouble with a metal problem?

TEAMING UP WITH INCO'S MECHANICAL ENGINEERING SECTION MAY HELP YOU COME UP WITH A PRACTICAL SOLUTION. AS A STARTER, WRITE **DEPARTMENT PE** FOR TECHNICAL BULLETIN "ENGINEERING PROPERTIES OF 'K' MONEL"

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67 Wall Street — New York 5, N. Y.

INCO

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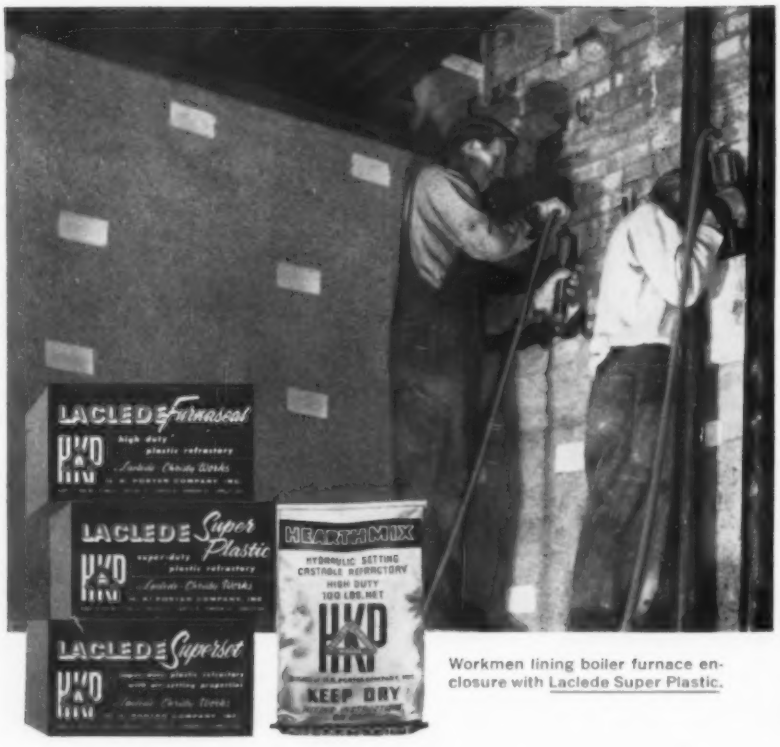

Workmen lining boiler furnace enclosure with Laclede Super Plastic.

Which of these advantages does your present boiler lining lack?

Laclede plastic and castable refractory linings, properly selected and installed, give long service life, greater efficiency, and permit more flexibility than other types of refractory linings.

Specific advantages for boiler constructions include

- High thermal shock resistance
- Long service life
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Use **Laclede** plastic refractories for front and bridge walls, burner ports, suspended arches, ignition arch construction, as a backing for water walls, and in other areas where high heat resistance is necessary. For complete details, contact your Laclede representative. Or write to *Laclede-Christy Works, Refractories Division, H. K. Porter Company, Inc., St. Louis 10, Mo. In Canada, H. K. Porter Company (Canada) Ltd., Guelph, Ontario.*

H. K. PORTER COMPANY, INC.
REFRACTORIES DIVISION

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Repairs Cut Down-Time

continued from page 87

repair returned the unit to service three months ahead of the best delivery date the manufacturer was able to promise for new blades.

Damaged Nozzle Partitions: — It is not unusual to discover that excessive steam cutting and cracks have occurred in the thin trailing edges of steam turbine nozzle partitions and stationary blading. Heavy erosion and serious cracks, of course, can be detected visually. Minor cracks, especially those along ragged, knife edges, must be located by one of the applicable non-destructive tests.

A common method of attempting to arrest the progress of a short crack across the flat section of a blade is to drill a small hole at the end of the crack. An element of risk enters in the determination of the exact location for the drilled hole. Incipient grain separation, imperceptible to ordinary testing methods, may exist at the far side of the "stopper" rendering the drilling ineffective, or the crack may change direction and bypass the hole completely. Extreme care and judgment are needed when this method is selected.

If the crack has not progressed so deeply that the strength of the partition or blade has been impaired, grinding may supply the simplest remedy. Notches formed by grinding should be provided with over-generous radii and transitions to avoid stress concentrations at the roots of sharp-angled grooves.

Thin, ragged trailing edges of blades are excellent starting places for cracks. It is advisable to grind back these jagged knife edges until a reasonably substantial thickness of metal has been reached. Angular corners and edges should be blended by grinding to present smooth rounded profiles.

Stainless Steel Piping Welds: — Within the past several years some difficulty has been experienced with the welded joints of the steam leads of a 60-mw steam turbine. These leads are of 8-in. diam Schedule 160 stainless steel pipe, type 347, 18-8 Cb, and operate at 1450 psig and 1050 F. Investigation disclosed that a number of welds had developed circumferential cracks in stringer or bead patterns extending in some cases 360 deg around the pipe. Most of these indications occurred along the fusion line of the parent and weld metal.

Work of removing these hundreds of defects followed the general procedure of grinding out the indication, adding weld metal where the depth of groove was excessive, polishing the surface of the weld to conform to the adjacent pipe surface and finally testing for soundness. If the defect cleared up *continued on page 134*

TONIGHT... new lights shine in America

Nation's First Commercial Electricity Produced From Atomic Power

It happened December 18, 1957, at Shippingport, Pennsylvania, U.S.A.

Not the familiar flash of a nuclear explosion but a silent surge of controlled power went out over the lines of Duquesne Light Company of Pittsburgh as the nation's first full-scale atomic power plant began to produce electricity for man's peace and progress. And around the world thoughtful men marked a new date on civilization's *constructive* calendar.

Heart of this 60,000 kilowatt plant lies below the ground in the core of the pressurized water reactor designed by Westinghouse Electric Corporation, prime contractor for A E C. Stone & Webster Engineering Corporation served Westinghouse as architect-engineer to develop the structural designs and construction drawings for the nuclear plant and to inspect the construction work.

Write or call our nearest office for information as to how our experience can be of assistance and profit to you.

STONE & WEBSTER ENGINEERING CORPORATION
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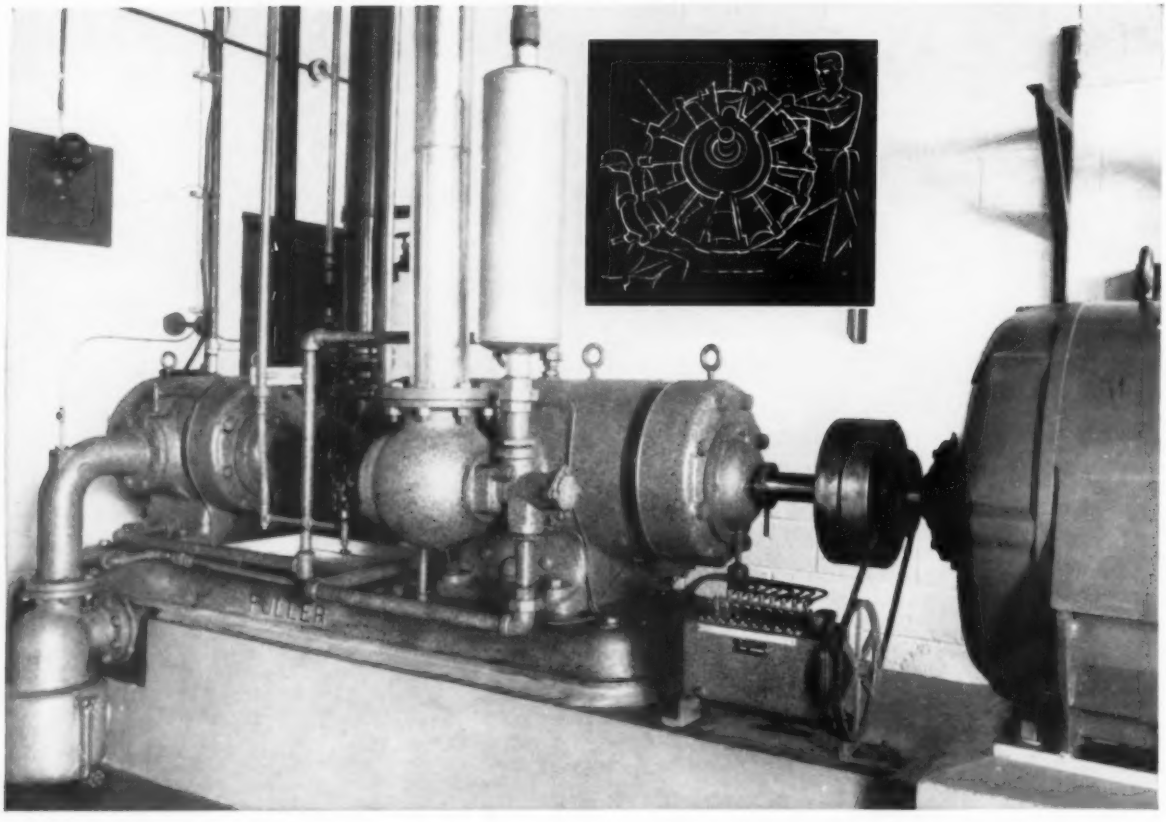

WHY DID AIRWORK SPECIFY A FULLER AIR COMPRESSOR?

Here's what the Vice President-Operations of Airwork Corporation, one of the nation's leading aircraft overhaul companies, writes about Fuller Model C-150-150H Rotary Air Compressors.

"We were running out of air capacity, and had decided that we would like to get rid of the maintenance problems inherent in a piston type air compressor.

"The Fuller compressor with its fewer moving parts and favorable price range met our basic requirements.

"We then checked on Fuller compressor performance through our close contacts with a leading manufacturer of aircraft engines. Their opinion was very favorable. We think Airwork has made the right decision."

Here are the features that sold Airwork on a Fuller Compressor:

- Wide seal between rotor and bottom of cylinder, assuring high volumetric efficiency.
- Rotary design assuring vibration-free flow of air.
- Direct drive.
- Compact space-saving installation.
- Simple foundation.
- No valves to leak or seats to grind.
- Few moving parts, keeping maintenance time to minimum.
- Designed for continuous duty service

When your plant needs reliable air power, call on Fuller. To get all the facts on Fuller Rotary Compressors for capacities up to 3300 C.F.M. and pressure to 125 pounds, write today,

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PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

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Unretouched photo shows what happens when a boiler feed line is clogged with calcium carbonate deposits.

CAUSE: lack of chemical stability in feed water.

REMEDY: properly balanced water treatment.

BUILD-UP FOR A BREAKDOWN

This heavy build-up of scale is not far from completely blocking the carrying capacity of this pipe. When the inevitable breakdown occurs, expensive maintenance and down time result.

You can save money by preventing costly breakdowns like this. The answer is proper water treatment wherever corrosive elements threaten.

A Consulting Service for You. Whatever your water problems...analysis, testing or treatment procedures for boiler water, condensate, cooling towers, process waters...Dearborn has the engineers, the experience and the laboratory facilities to assist you in developing the program exactly suited to your needs. Your Dearborn Engineer will outline the many advantages a Dearborn Consulting Service Program will give you.

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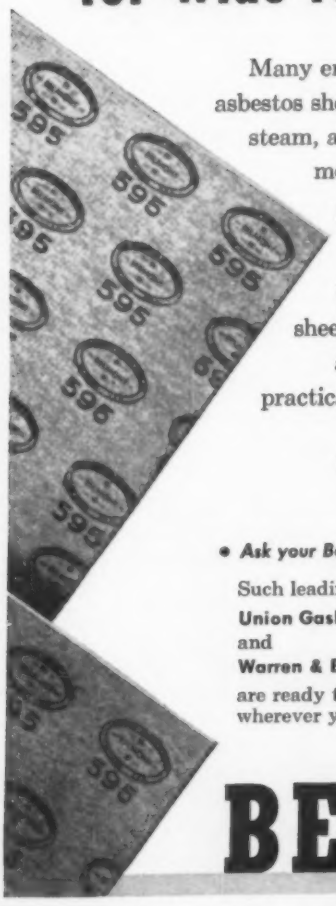

Many engineers call Belmont's compressed asbestos sheet packings for dry and saturated steam, air, gas, oil, solvents, ammonia and most chemicals—"the handiest sheet packings in the plant."

Various compositions and special binders, all thicknesses 1/64" to 3/16", sheet sizes to 150" x 150", or supplied as cut gaskets to specifications, for practically all maintenance requirements.

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Repairs Cut Down-Time

continued from page 130

at a depth less than 1/8-in. below the OD of the pipe, no metal was added. Edges of the resulting depression were carefully blended to provide smooth contours, sharp ridges and short-radius curves being removed.

In the more serious cases, the cycle of grinding and die-checking was continued until the cracks bottomed. Typical examples are shown in Figs. 10 and 11. In several joints, indications were pursued entirely through the 0.891-in.-thick wall.

Welding repairs did not, in all cases, proceed smoothly. Cracks showed up along lines of fusion both in the freshly-added weld metal and in the original pipe material. Several of the type 347 rods with controlled ferrite, both coated and uncoated, were used, none of which demonstrated universally superior qualities.

A variety of techniques was applied in laying in weld metal at the troublesome joints, the principal aim being to inhibit the detrimental effects of sustained concentrations of heat. Light stringer beads instead of weaving were specified, back stepping was used, heliarc using argon gas with bare wire was tried. Where practicable, cooling water was used to arrest heat propagation. "Buttering" or applying a thin layer of weld metal over a broad area was employed to reduce the severity of stress buildup. Anchors or bumpers were built up on the parent metal adjacent to the cavity being filled in an attempt to flatten out the stress gradient across the heat affected zones.

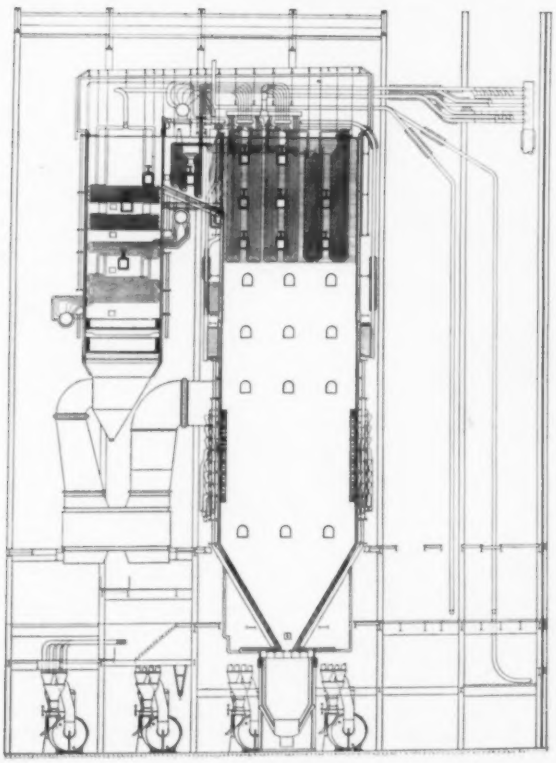
Periodic checks were made as the welding progressed to detect any tendency toward formation of cracks. For example, inspections were made every 1/4-in. thickness of added weld metal, and in the more troublesome joints the metal was ground and tested after every third bead. For removal of defective metal and polishing, high speed rotary burrs or files and aluminum oxide wheels were used, extreme care being taken to avoid high contact temperatures.

Combinations of these techniques, plus persistence and patience were successful in producing clear, sound joints in all cases.

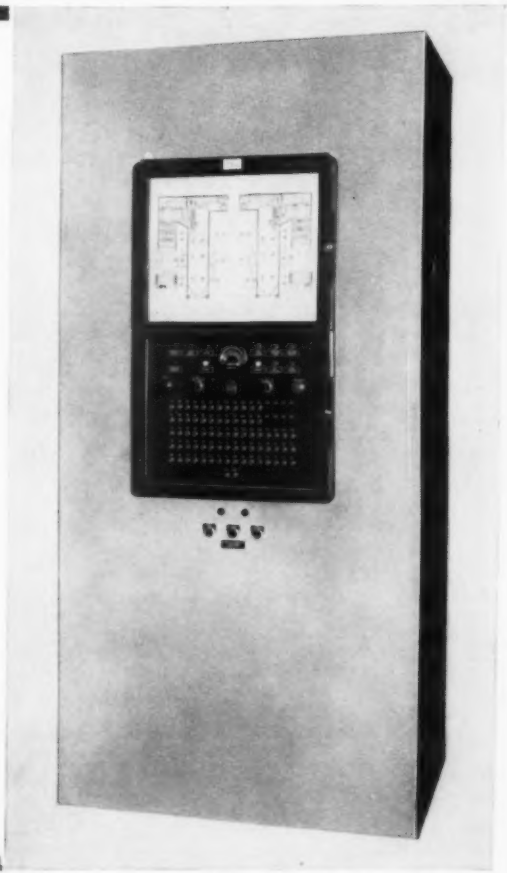
Conclusion

In the foregoing discussion, emphasis has been placed on the repair function of engineering maintenance as differentiated from direct replacement of parts. Accordingly, many of the methods outlined were dictated largely by necessity and expediency, economic considerations being secondary. Although other circumstances might have suggested completely different approaches, nonetheless a primary aim of maintenance was achieved in that the apparatus was returned to service without undue delay. THE END

How Copes-Vulcan control systems boost power plant efficiency



Showcase super-critical steam generator will be equipped with a Selective-Sequence System that includes Vulcan T-30 long retractables with 30 to 37-foot travels, half 'tracts with 19-foot travels. Wall deslaggers and air-preheater cleaner controls will also be used.



Nerve center for precision boiler cleaning, the SSC-120 Selective-Sequence Controller is pre-wired and factory assembled for positive control. It handles up to four cycles for each blower. A 60-station model is also available.

Vulcan soot blowing system saves steam, air and manpower

A Vulcan Selective-Sequence System gives the operator the ultimate in finger tip control of *individual* soot blowers. He can set up a sequence to assure thorough boiler cleaning and forget it. He can monitor the program at a glance, stop it, restart it or change any soot blower from any point in the sequence to another to improve cleaning or conserve the blowing medium. Here's complete flexibility without extensive time consuming wiring and piping changes.

Besides Selective-Sequence, Vulcan also builds Automatic-Sequential Systems that can use steam and/or air without a change in equipment, and can provide both simple automatic or manual control.

A complete line . . . a complete service

Over 50 years of design experience backs Copes-Vulcan's broad line of control systems for boiler cleaning, combustion, feed water, pressure reducing and desuperheating.

Whether furnished in individual units or integrated into a single system, each installation gets custom design, skilled continuing service. Trained service men help set up a routine inspection-maintenance program . . . visit each installation periodically.

Bulletin 1029 details Vulcan Automatic Soot Blowing Systems. Write for your copy today.

Copes-Vulcan Division
BLAW-KNOX COMPANY
Erie 4, Pennsylvania

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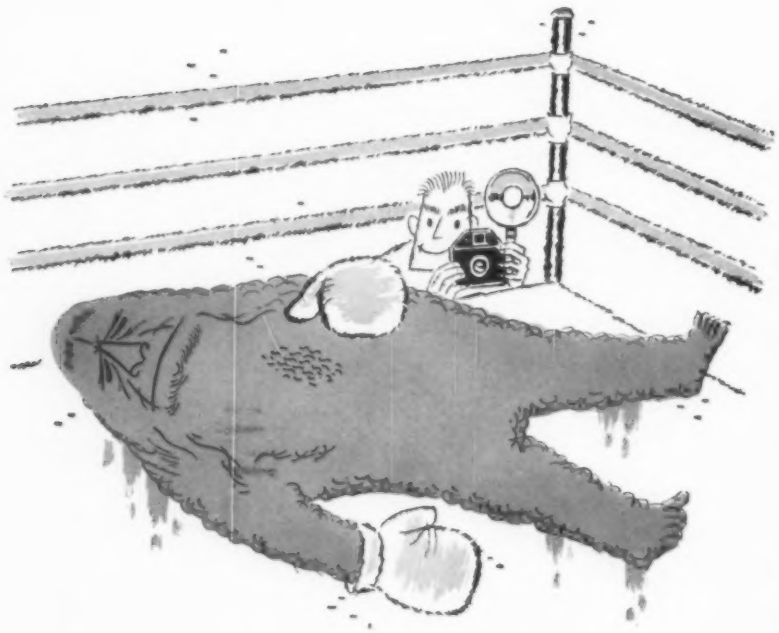

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Operation of Pumps

continued from page 93

on pump 1, and a pressure due to the boiler feed regulator. We then have conditions shown by the solid lines.

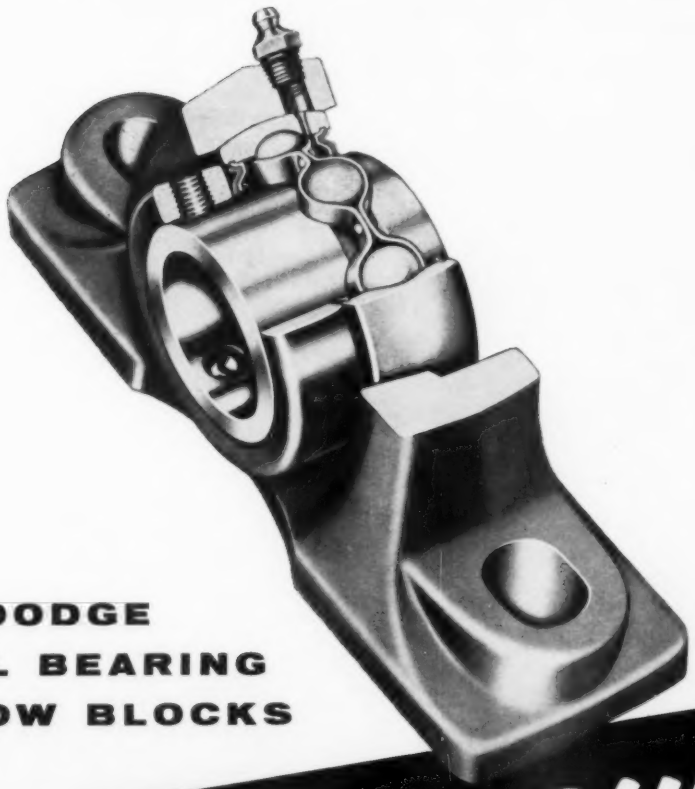
Remember again, $h_1 = h_2 = h$ system, and $gpm_1 + gpm_2 = gpm$ system. Let us assume that the previous graph represents an operating condition. What happens if we require more water in the boiler? The gpm of the system will change as shown by the dotted line on the system curve (draw in dotted line on system curve). The required head goes up as shown by the horizontal dotted line (draw in dotted line to represent the new system pressure). Now we should know which of the pumps will change in delivery. Assume that pump 1 is constant speed, so that increased head will lessen the delivery (drawn in vercal dotted line on gpm_1 to show delivery). If we have 100 per cent delivery to the boiler, and pump 1 puts out 40 per cent, then pump 2 will have to put out 60 per cent. (Draw vertical dotted line 60 per cent of gpm_2 to dotted pressure line.)

Let us replot the previous figure and see what would happen in case 1, reduction of boiler flow requirement without closing the regulator valve with steam pressure rise, 2, reduction of boiler flow requirement by closing the feedwater regulator, and 3, opening of the feedwater valve to permit increased boiler flow (Fig. 14).

Shaded area represents drop through feedwater regulator, at normal flow, say 90 per cent. Case 1 is shown by dotted line. The constant speed pump delivery increases, and the turbine pump delivery decreases (again dependent on its type of control). The opposite occurs in case of a flow increase. The dashed line, case 2, shows the effect of closing down the feedwater regulator to adjust flow to the same quantity as in case 1. Pump 1 will deliver less, and pump 2 will change speed somewhat and deliver less, as required by the system. The system gpm is set by the feedwater regulator, and the pumps are adjusted by the controls.

We can see the effect of throttling the pump discharge, of changing pump speed or boiler feedwater regulator setting, or any other circumstance. With two single-speed pumps, of course, the curves are somewhat simpler. Simplest of all is the case of two pumps on the same line with single speeds and no control. This case is usually the cause of most trouble. This type of analysis is a very graphic solution to such a problem set-up.

Just remember, if both pumps are on the same system, the discharge of both pumps equals the system flow, and the head pressures are equal at both pump discharges, to the system head for a specific flow. In the pumps themselves, the pressures may, of course, be higher if the discharge valve is partly closed. THE END



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- ★ High quality at moderate cost.
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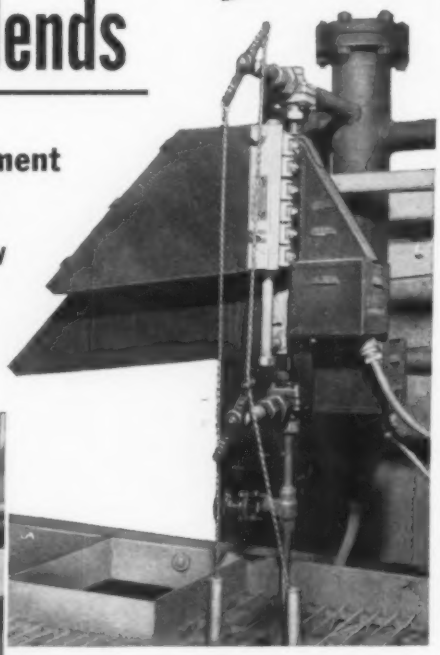
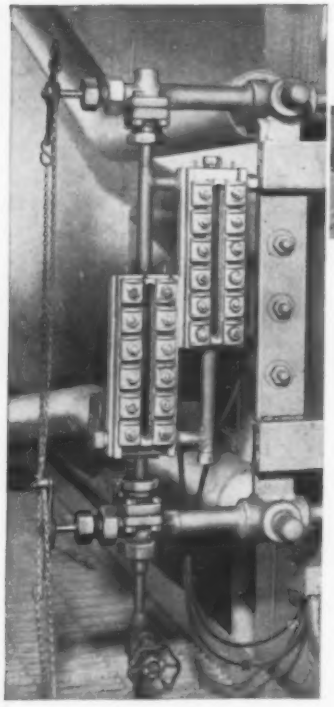
Boiler Water Level Security Pays Dividends

... Reliance Equipment insures safe, sure supervision for low or high pressure plants





"Two water gages on all boilers operating at over 400 psi" says the code. Here's an example, in the municipal light and power plant of Coffeyville, Kans., illustrating modern Reliance 900 psi equipment.

Water column includes whistle alarm; is equipped with flat glass gage insert, periscope hoods to reflect image through cat-walk opening to a floor-stand mirror below; and mercury lamp illuminator for sharp, brilliant projection. The second gage, also of double-window flat glass construction, is custom-made with tie-bar, for direct-to-drum installation.

Reliance builds for all pressures — brings you a complete line of boiler safety devices. The long record of efficient, dependable service — the extra margin of safety built into all Reliance Equipment — assures long life and low maintenance. Check with your consultants or ask for nearest Reliance Representative address.

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Engineered Work Measurement, by Delmar W. Karger and F. H. Bavha. 635 pages, 6 by 9 in., cloth bound. Published by The Industrial Press, 93 Worth St., New York 13, N. Y. Price $12.00.

Industry has long sought a system of work measurement based on sound, practical operating experience, and which would be acceptable to management and labor alike.

The system now known as Methods Time Measurement, or "MTM", has become the accepted standard for the United States and foreign countries alike. It is based on predetermined time values which have been arrived at by direct observation, visualization, and data synthesis. The system is so generally acceptable because it takes into account all known variables, and evaluates them on a scientific and engineered basis.

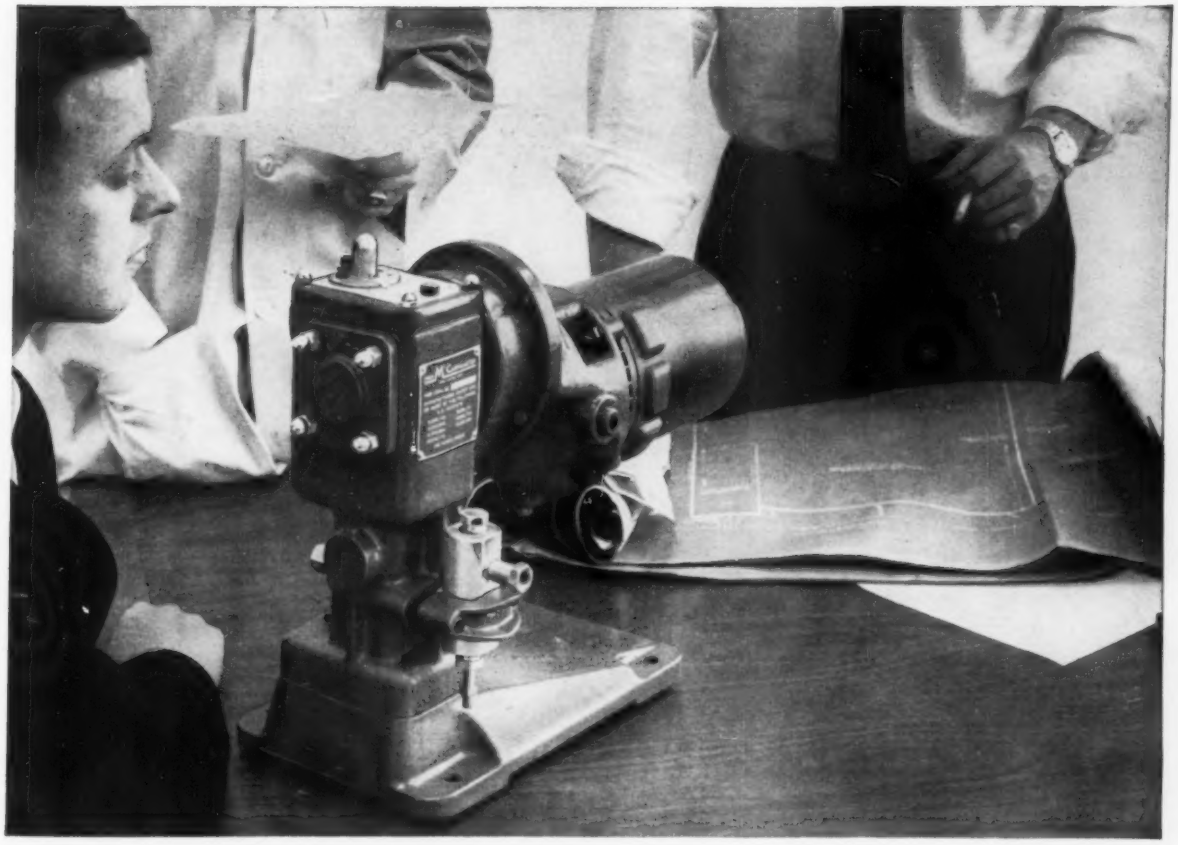
Here, apparently for the first time, the authors have done an outstanding job in presenting a complete and practical treatment of a highly specialized subject. The book presents the background, fundamentals, and working applications of all phases of work measurement. The text is suited equally well for students, practising engineers, consultants, and management in general. Due to many years of combined practical experience in industry, the authors have written with authority, and have not overlooked the all-important human side of the equation.

★ ★ ★

Linear Transient Analysis, Vol. II, by Ernst Weber. First Edition, 452 pages, 6¼ by 9¼ in., cloth. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y., 1956. Price $10.50.

This book begins with a brief review of the Fournier and Laplace transforms. It stresses these tools in the areas where they offer greatest advantage over classical methods. Following logically after Volume I, this second volume presupposes a knowledge of the functions of a complex variable and familiarity with simple lumped circuits. Five appendices, however, provide mathematical background and help make the work self-sufficient.

The book includes an unusually comprehensive treatment of the two-terminal-pair network. Simple matric algebra systematizes this presentation and permits considerable generalization of solutions of fourpole problems. Based upon years of teaching experience, this work is by nature a mathematical presentation, yet the author has managed to show numerous practical applications in great detail. He brings out the physical background and stresses physical interpretations of solutions.



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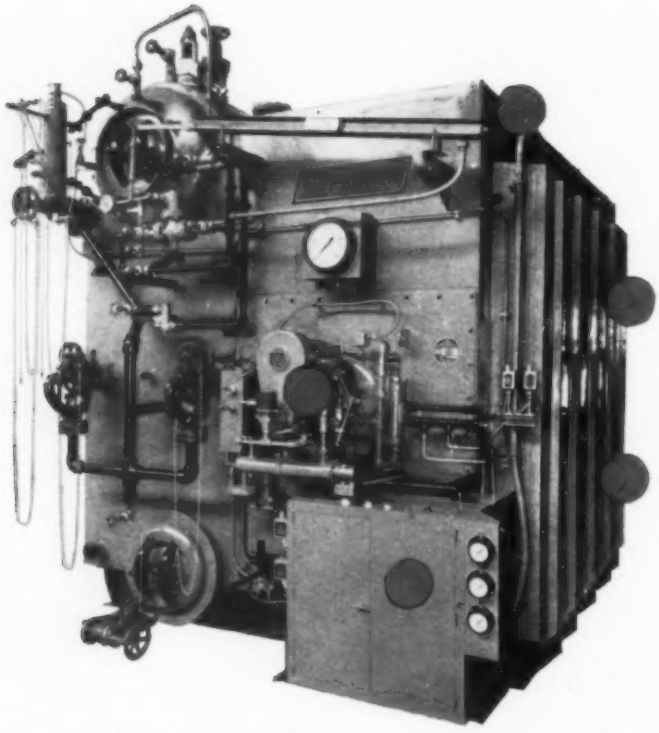

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201 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, uses, properties. Standard Oil Co. (Ind.)

202 Lubricants — Specification, Classification — Vital information on selection of lubricants is presented in 10-pp Vol. 41, No. 4 of "Lubrication." Covers such items as performance specifications, initial suitability of lubricants, quality of lubricant, effect of lubricant on production, effect on maintenance, effect on power, effect on cost, and features a look to the future. The Texas Co.

203 Lithium Greases — This product information bulletin presents manufacturer's six Litholine industrial greases, stressing industry advantages offered by these multi-purpose greases. Gives properties of the greases, general application and performance characteristics and includes test data. Sinclair Refining Co.

WATER CONDITIONING

204 Feedwater Heaters — Open-Coil, tray-type feedwater heaters and purifiers of both deaerating and non-deaerating type are presented in 12-pp Bulletin 117-A. Construction and operational features of the heaters are explained and illustrated, and more than a dozen available models are pictured along with application suggestions. They cover capacities from 3000 to 300,000 lb per hour. Stickle Steam Specialties Co.

205 Water Treatment—Bulletin 5000, 24 pp, explains the reason for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

206 Evaluating Steam Purity — Technical Paper 135, 88 pp, entitled "Conductivity vs Sodium by Flame Spectrophotometry In Steam-Purity Studies," presents results of laboratory and plant work to indicate that sodium is extremely valuable in evaluating steam purity. Performance curves are included in the paper. Betz Laboratories, Inc.

207 Steam System Treatment — This bulletin on Coravol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants

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101	102	103	104	105	106	107	108	109	110	111
112	113	114	115	116	117	118	119	120	121	122
123	124	125	126	127	128	129	130	131	132	133
134	135	136	137	138	139	140	141	142	143	144
145	146	147	148	149	150	151	152	153	154	155
156	157	158	159	160	161	162	163	164	165	166
167	168	169	170	171	172	173	174	175	176	177

Equipment

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33
34	35	36	37	38	39	40	41	42	43	44

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201	202	203	204	205	206	207	208	209	210	211
212	213	214	215	216	217	218	219	220	221	222
223	224	225	226	227	228	229	230	231	232	233
234	235	236	237	238	239	240	241	242	243	244
245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266
267	268	269	270	271	272	273	274	275	276	277
278	279	280	281	282	283	284	285	286	287	288
289	290	291	292	293	294	295	296	297	298	299

Advertised Products and Services

501	502	503	504	505	506	507	508	509	510	511
512	513	514	515	516	517	518	519	520	521	522
523	524	525	526	527	528	529	530	531	532	533
534	535	536	537	538	539	540	541	542	543	544
545	546	547	548	549	550	551	552	553	554	555
556	557	558	559	560	561	562	563	564	565	566
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and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

208 For Boiler Protection — Scav-Ox, a 35 per cent hydrazine solution for removing dissolved oxygen from boiler feedwater, is described in this 16-pp illustrated booklet. It covers in detail the use of the solution for protecting low, medium and high pressure boilers, discussing determination of dosage, recommended methods of application, testing methods for hydrazine, and properties and handling of the material. Comprehensive operating data given. Olin Mathieson Chemical Corp.

209 Boiler Water Treatment — Chemical reduction of oxygen in boiler feedwater with hydrazine is the subject of 10-pp Bulletin BW-7. Economy and operation, handling of the Deoxy-Sol, methods of analysis and other details are covered. A bibliography lists supplementary reading. Fairmont Chemical Co., Inc.

210 Handbook on Demineralizing — Comprehensive 40-pp Bulletin 5800 compares various methods of water treatment, indicating the comparison between demineralizers and evaporators. It discusses the characteristics of the various types of available cation and anion exchange materials and offers data on operating costs of demineralizing. It tells when to use two-bed, three-bed, four-bed, mixed or mono-bed demineralizers. It also indicates when decarbonators or vacuum deaerators should be installed. Cochrane Corp.

211 pH and Chlorine Control — The 12th edition of company's handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrate, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica nitrate hardness. Available to qualified power engineers. W. A. Taylor Co.

212 Mixed-Bed De-Ionizers—Practical equipment for mixed-bed de-ionization at flow rates of 5 gph to 5000 gpm is described in this 8-pp bulletin. Advantages of construction and design are detailed, as well as mechanical features, installation operation. Illinois Water Treatment Co.

214 Cooling System Treatment — Bulletin C1 describes advantages of company's treatment for cooling tower systems with synergised polyphosphates. Details of the system are fully covered. National Aluminate Corp.

MECHANICAL POWER TRANSMISSION

215 V-S Drive Selection Tips — Bulletin 20P50, 44 pp, carries handy multicolor tables for quick and easy selection of variable speed Texrope drives. In addition to providing these tables for A, B, C and D section variable speed drives, booklet includes information on design features, drive principles, horsepower rating tables, speed range table. Allis-Chalmers Mfg. Co.

216 Internally Geared Power — Featuring latest design improvements in

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9	10	11	12	115	116	117	118	119	120	121	234	235	236	237	238	239	240	241	242	243	244
13	14	15	16	122	123	124	125	126	127	128	245	246	247	248	249	250	251	252	253	254	255
17	18	19	20	129	130	131	132	133	134	135	256	257	258	259	260	261	262	263	264	265	266
21	22	23	24	136	137	138	139	140	141	142	267	268	269	270	271	272	273	274	275	276	277
23	26	27	28	143	144	145	146	147	148	149	278	279	280	281	282	283	284	285	286	287	288
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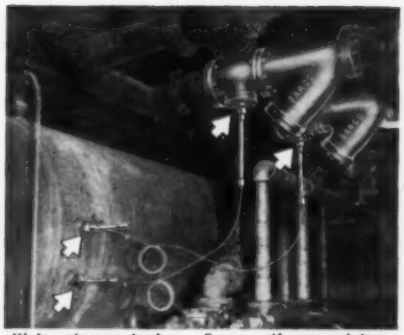
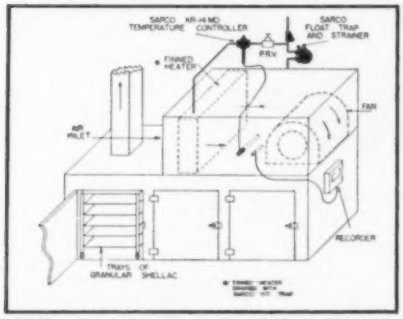


Water storage tanks — Sarco self-powered temperature controls on service water storage tanks from twin heaters.



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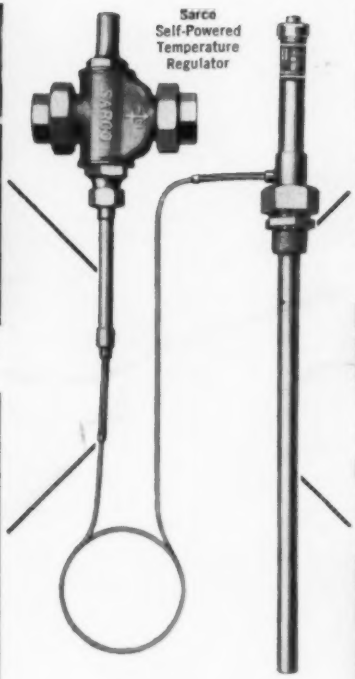

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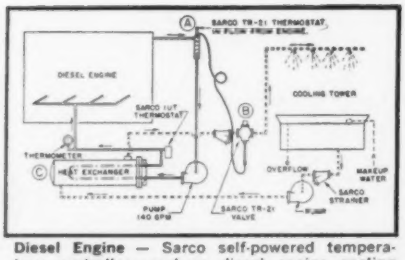
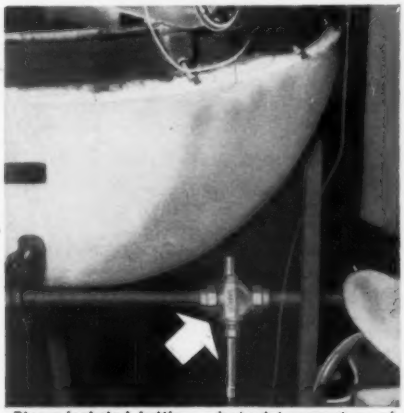


Diesel Engine — Sarco self-powered temperature controller used on diesel engine cooling system. Also ideal for compressors.



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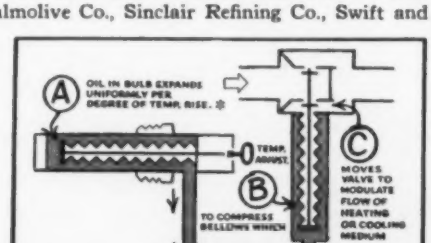
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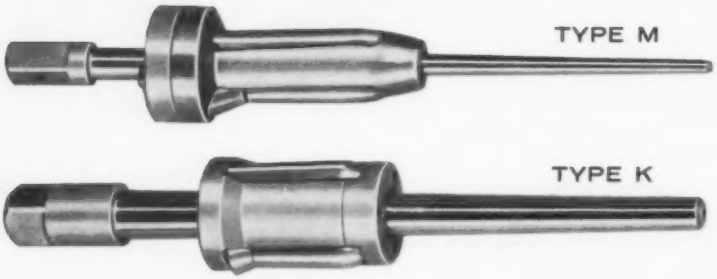

This 16-page bulletin describes general types of Elliott boiler tube expanders for fast, efficient tube rolling jobs. It also gives dimensions, prices and other descriptive data and shows various drum, header and short series mandrels which are used with Elliott boiler tube expanders. Drum mandrels are seen with Type M and Type K above.

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gearmotors and embodying 60 multicolor illustrations, 16-pp Form F-1880 shows comparative advantages of gearmotors, lists ratings from ⅛ to 30 hp with gear ratios as high as 10:1. Cross-sectional details and enlargements of outstanding features are included, as well as a discussion of use of elliptoidal helical gears, and a chart graphing degrees of tempering of gear teeth. U. S. Electrical Motors Inc.

217 Flexible Cushion Coupling — Bulletin A669, 12 pp, describes the Paraflex, a flexible cushion coupling, designed to automatically compensate for all combinations of misalignment and end float. Cutaway views and drawings are included, as well as coupling selection data and a table listing service factors for couplings. Dodge Mfg. Corp.

218 Fluid Drive — Advantages and applications of company's fluid drives which offer adjustable, stepless speed control for a wide variety of industrial applications are detailed in 8-pp Bulletin A-119. Components and operation are described and selection tables and dimensions given. American Blower Corp.

PUMPS, COMPRESSORS

219 Controlled Volume Pumps — Bulletin 953, 24 pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water testing systems are presented through text and diagrams; and an analysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment, included. Milton Roy Co.

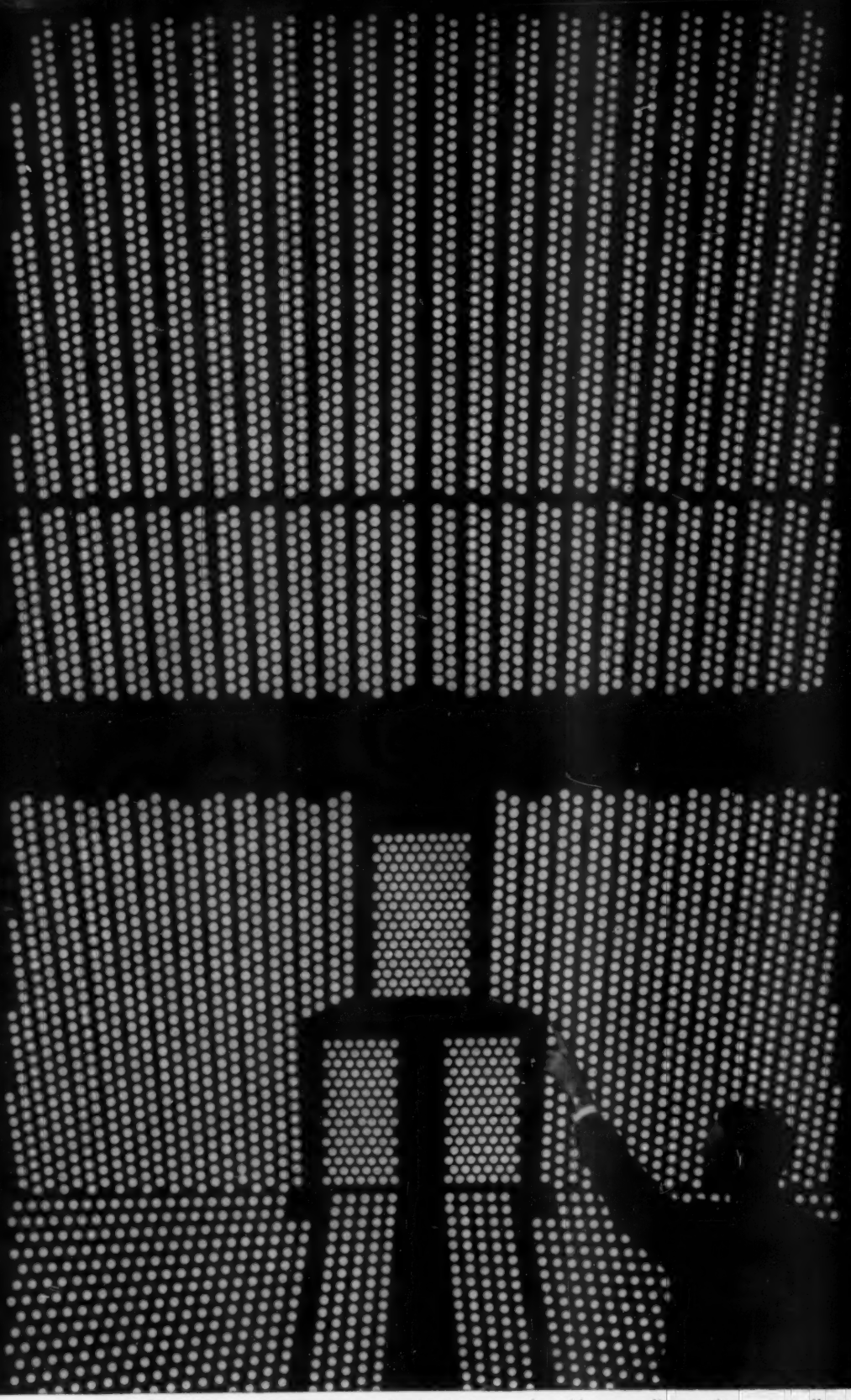
220 Proportioning Pumps — Catalog 602, 8 pp, covers details and specifications of two mechanical and hydraulic drive metering and proportioning pumps, for precision pumping as low as 11 cc per min, and a chemical pump for systems requiring limited capacities. Advantages are enumerated and capacities and pressures tabulated. Hills-McCanna Co.

221 Solids Handling Pumps — Bulletin 121-A, 8 pp, describes a complete line of non-clog pumps for handling solids in suspension. Included are vertical, horizontal and close-coupled types used to handle liquid components of industrial processes, industrial waste, and for such pumping applications as water supply, drainage and sewage handling. Specifications are included. Aurora Pump Div., The New York Air Brake Co.

222 Industrial Air Compressors — Twelve-pp Bulletin A-43 describes company's vertical design industrial air compressors supplying moderate amounts of air on a continuous 24-hr heavy-duty basis. Design features are described and illustrated by means of a cutaway view, and specifications and dimensions are tabulated. Joy Mfg. Co.

PACKINGS, SEALS

223 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing applications. Packing Div., Raybestos-Manhattan, Inc.



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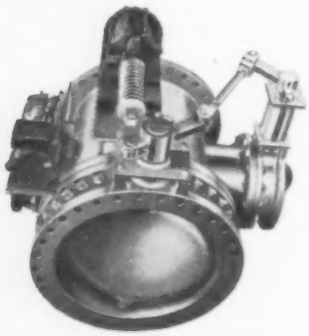

Special four-way valve for hot air and exhaust gases in a gas turbine system; has 3 butterfly valves mounted on a steel pipe cross, with 2 valves connected to one hydraulic cylinder operator and one valve connected to an air cylinder with valve positioner for independent balancing purposes.

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224 Mechanical Packings — Featured in 24-pp Catalog 56 are several recent packing developments including the multi-purpose Bel-Vee V-Ring packings, the long wearing criss-cross Braid packing series, twisted foil packings for oil and distillate temperatures to 1000 F, and an Inconel-wire reinforced plastic packing for valves handling superheated steam at temperatures up to 800 C. Packings for every industrial application are covered and a recommendation chart is included. The Belmont Packing & Rubber Co.

225 Packing Catalog — Catalog 54 contains literature on company's line of packings and gaskets to serve a variety of industrial needs. Among the items featured are metallic packings, fibrous packings, plastic packings, gaskets and sheet packing, as well as high-temperature anti-seize compounds. A section of engineering data and conversion tables is included. Felt Products Mfg. Co.

226 Mechanical Seals — Bulletin S-205-2, 8-pp, covers the complete line of chemically inert mechanical seals for handling all types acids, corrosives, solvents and gases. Provides construction, service and application information, installations and engineering details. Crane Packing Co.

BOILERS, GENERATORS

227 Water Tube Boilers — This 12-pp catalog describes packaged water tube boilers, in capacities from 8000 to 50,000 lb per hour. Interesting as well as informative, this booklet uses color and illustrations to amplify text. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

228 Automatic Boilers — Bulletin BE-4 describes operation and advantages of Continental automatic boiler's spinning gas technique — a method of obtaining maximum heat transfer with a simplified design. Shows cutaway view of boiler construction; illustrates hinged doors and method of injecting air. Boiler Engineering & Supply Co., Inc.

229 Hot Water Boilers — This 20-pp brochure describes and illustrates design, construction, advantages and economies of the C-E La Mont controlled circulation hot water boiler for supplying high pressure, high temperature water for heating systems and process applications. Combustion Engineering, Inc.

230 Steam Generators — Twelve-pp Bulletin PSG-2 contains design and construction details on company's package unit steam generator — a vertical, bent tube, longitudinally fired water tube boiler. Capacities, dimensions and weights are tabulated and drawings, diagrams and photos showing fabricating methods included. Henry Vogt Machine Co.

231 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie-City Iron Works.

232 Standard Generators — Bulletin B-55-4 describes company's SC economy series of standard steam generators designed to reduce steam costs for industrial plants. Pre-engineered, standardized

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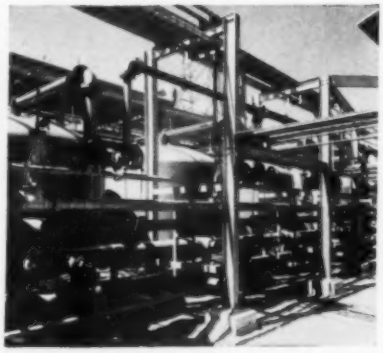

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steam generators offered in nine sizes, with capacities of from 50,000 to 150,000 lb per hour are described, and schematic and cutaway drawings of design features are included. Foster Wheeler Corp.

233 Compact Generator — This bulletin describes a packaged water tube generator, company's Type DK, available in units for 8400 to 45,000 lb of steam per hour. Gives features, size and capacity data on these boilers which are designed to require less space than many water tube units. E. Keeler Co.

234 Packaged Generators — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are furnished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

TUBING AND ACCESSORIES

235 Heat Exchanger Tubing — Cited in this 30-pp catalog are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pollution, excessive turbulence, temperature and the like, required such tubing. The International Nickel Co., Inc.

236 Tube Expanders — Catalog 88, 119 pp, is full of detailed information about tube expanders and associated tools used for tube rolling. Profusely illustrated, catalog provides information relative to boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections are devoted to expanders, accessories, measuring instruments, rollers, extensions and drives. Each type of equipment is fully described, applications are listed, and tables of engineering data included. Also covers tube expansion methods, tool maintenance, expansion calculations and charts giving sizes. Thomas C. Wilson, Inc.

Postage-free cards for ordering catalogs are on page 141. You may also use the cards to order literature mentioned in the ads.

237 Tube Expanders, Cutters — Catalog 81, 32 pp, contains specifications of company's line of tube cutters and expanders for fire tube and water tube boilers, condensers-coolers, heat transfer units, refinery still tubes, others. Also gives necessary information on operating accessories. Many excellent demonstrations of product application are included among the 300 illustrations provided, as well as tables of sizes, ordering tips and distributors. The Gustav Wiedeke Co.

238 Tube Cleaners — Bulletin G-515 describes company's line of air, steam and water driven tube cleaners and accessories. Photos of the various types of cleaners are included, along with descriptive details and specification data. Elliott Co. — Roto Plant, Div. of Carrier Corp.

239 Life Extension for Condenser Tubes — The 32-pp current edition of this booklet reports on research into the causes

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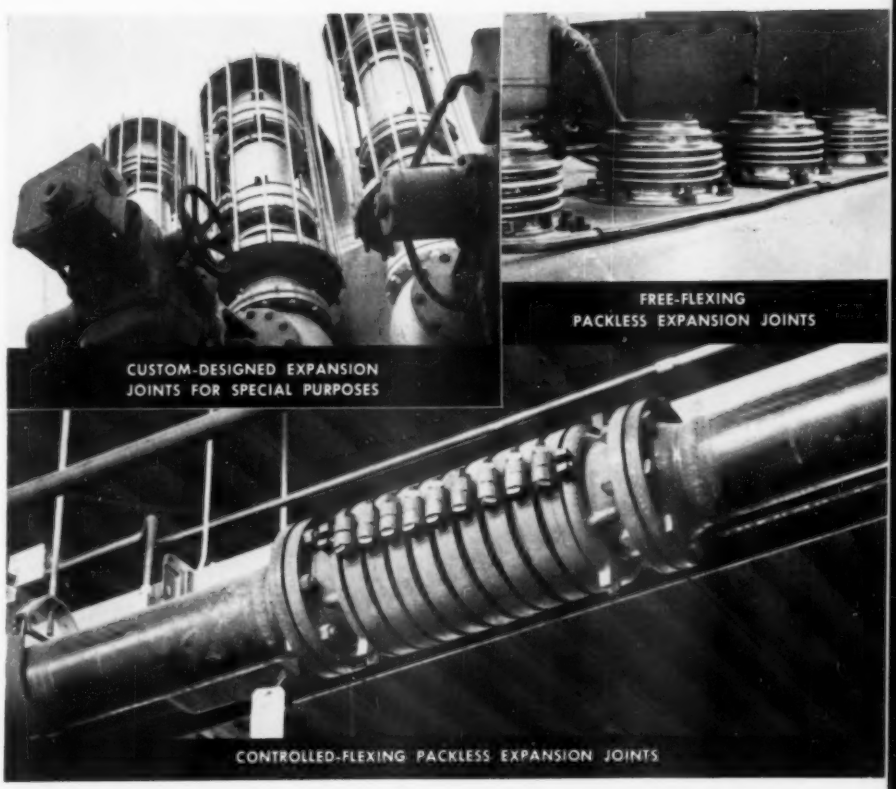
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of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in others. Revere Copper and Brass, Inc.

FUEL BURNING EQUIPMENT

240 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

241 For Burning Refuse Fuel — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses construction features of various components. Riley Stoker Corp.

242 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

COAL AND ASH HANDLING

243 Shredders, Crushers — Bulletin 257 describes and illustrates hammermills and shredders, rolling ring and special crushers for reducing chemicals, minerals, ceramics, and other materials including wood waste. Discusses construction features of the line and includes dimensions. American Pulverizer Co.

244 Improved Crushers — Bulletin 12-C, 16-pp, describes company's line of crushers for reducing coal, coke, glass cullet, gypsum, lime, metal turning, sugar, sulphur and similar lump materials. Covers Knittel ring type crushers, two-stage double-roll crushers, single-roll crushers, and double-roll crushers. Photos, dimensional drawings and full specifications are included. Stephens-Adamson Mfg. Co.

245 Jet Ignition Stoker — Information regarding company's jet ignition stoker is presented in Bulletin G-85. Rapid response to load change, ignition stability, efficient combustion, and a simple hydraulic drive are features described. Jet ignition stokers adapted to boilers in specific industries are shown and a typical fuel chart with comments and ASTM rank is also included. Babcock & Wilcox Co.

246 Spreader Stoker — Advantages and features of company's continuous ash discharge spreader stoker are detailed in this 24-pp bulletin. Illustrates and describes operation details, and includes diagrammatically illustrated specifications, schematic diagrams showing installations with various types of boilers, and photos of typical installations. Detroit Stoker Co.

ELECTRICAL EQUIPMENT

247 Testing Instruments — Bulletin 19-58, 16 pp, features company's elec-

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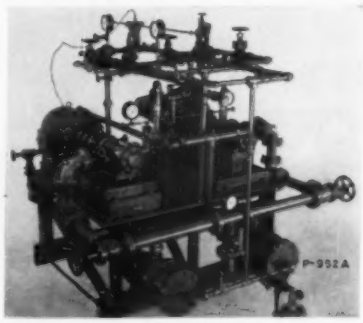

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trical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, including chief features, operating ranges, and applications. James G. Biddle Co.

248 Selecting Protective Devices — The Protection Handbook, 24 pp, is based on the 1956 National Electrical Code, and interprets this code into easily read form. It covers the selection of protective devices for electric circuits, motors, appliances and apparatus, and includes a list showing the size to use when ordinary fuse, Fustron dual-element fuse or Fustat is installed. All information is condensed. Fully illustrated, book gives wiring diagrams, motor tables. Bussmann Mfg. Co.

249 Cable Troughs — This 12-pp catalog offers a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings, horizontal elbows, inside and outside vertical elbows, ties, crosses, covers and many special fastening devices to save time and labor. Contains full instructions for installations, load charts, accessory items, some typical installations and full list of distributors. The Globe Co.

REFRACTORIES, INSULATIONS

250 Refractory Concrete — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

Postage-free cards for ordering catalogs are on page 141. You may also use the cards to order literature mentioned in the ads.

252 Refractory Cement — Heavy duty brick bonding and patching mortar is described in this 8-pp illustrated color folder. Includes success stories concerning the product's application in high temperature work and in the protection of equipment against slag, fly ash and gases. Refractory and Insulation Corp.

253 Condensed Refractory Data — Six-pp Bulletin 128A covers briefly this manufacturer's line of refractory products. Covers fire brick, silica brick, acid- and abrasion-resistant brick, cements and mortars, plastic fire brick, castables, coatings and insulating fire brick. Data given, including softening points, uses, etc., is presented in tabular form. Laclede-Christy Works ,H. K. Porter Co., Inc.

254 Pipe Insulation — This 40-pp catalog was designed as a reference guide to company's pipe insulation, presenting a new way to specify proper thickness for pipe insulation, based on the "J" factor. This special index eliminates complicated computation formerly required to determine economical thicknesses. The book also features detailed drawings that show how single-layer insulation is applied to various vertical and horizontal expansion

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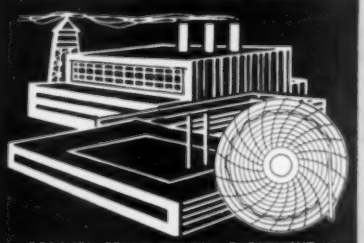

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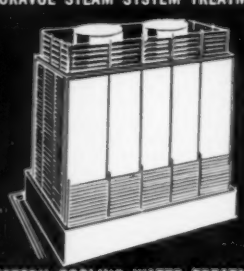

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joints as well as to pipe bends, flanges, valves and fittings. Charts and tables list physical and thermal characteristics. Union Asbestos & Rubber Co.

255 Insulations, Refractories — This 20-pp catalog features thermal insulations and refractories for general industrial applications. Organized for quick reference, catalog provides information on composition, physical and thermal properties and sizes of the various products. Lists chief advantages, covers materials for efficient control of temperatures from −400 F to 3000 F. Johns-Manville.

VALVES, TRAPS AND PIPING

257 Boiler Blow Off Valves — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

258 Water Hammer Control — Cause, effect and control of water hammer in piping systems is the subject of 8-pp Bulletin WH 851. Photos, drawings and curves supplement text, and test data is presented to show efficiency of company's silent check valves in water hammer control. Some typical installations are illustrated. The Williams Gauge Co., Inc.

259 Composite Valves — This 24-pp catalog, Form 186, features company's line of bronze, iron, steel and corrosion resistant valves. In addition to descriptions of component features, it contains photos, cutaway views and complete specifications. The Wm. Powell Co.

260 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in nontechnical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are discussed and illustrated. Crane Co.

261 Industrial Valves — Bulletin 507V illustrates and describes company's line of industrial valves for control of air, gas, liquids and solids. Features photos and descriptive detail on a variety of valves, including butterfly valves, wafer butterfly valves, treaded butterfly valves, slide valves, check valves, proportioning valves and others. W. S. Rockwell Co.

262 Industrial Valves — Condensed Catalog 105, 28 pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Also included is company's Mudwonder valve for abrasive fluids. Edward Valves, Inc.

263 Butterfly Valve Manual — Forty-pp Catalog B-2 is designed to help power engineers select valve types, understand their characteristics, and determine space requirements. It includes such useful data as: pressure drop and flow tables, conversion tables, theory and application, recommended materials, and describes rubber seat butterfly valves from 4 in. diam up, for handling liquids and gases. Photos, drawings and diagrams amplify the text. The Henry Pratt Co.

264 Valve Digest — Form 197R is a valve catalog digest furnishing the latest coverage of the OIC bronze, iron, cast steel, forged steel, and lubricated plug valve lines in a condensed form. Valves are classified by type and pressure class, and illustrated; this edition also includes face to face dimensions for each size and type of valve listed. The Ohio Injector Co.

265 Impulse Steam Trap — Bulletin T-1742, 8 pp, describes a line of impulse steam traps designed for a variety of trapping requirements. Contains information on operation, materials and capacities and includes dimensional and specification data, as well as photos of typical installations. Yarnall-Waring Co.

266 Trap Service Guide — To promote better trapping practice, pocket-size 32-pp Bulletin 7511 offers practical tips on installation, testing, and maintenance. Chapters are devoted to inspection and repair, trouble shooting, parts identification. Capacity charts are provided, also tables showing interchangeability of company's trap parts. Other sections deal with strainers, check valves, automatic trap drains. Armstrong Machine Works.

268 Insulated Piping — Bulletin 57-1, 24 pp, on prefabricated insulated piping systems, shows typical uses for Hel-cor pipe units for underground or overhead pipe systems. Also describes Utilidor conduits for protection of underground utility services. Sample specifications are given, along with conduit sizing charts. Ric-wiL, Inc.

269 Materials for Main Steam Piping — Entitled "The Plastic Ductility of Austenitic Piping Containing Welded Joints At 1200 F," this 16-pp bulletin deals with an investigation into the problem of selection of materials for main steam piping. Gives stress rupture characteristics of type 316 and 347 stainless steel piping adjacent to welded joints. Pittsburgh Piping and Equipment Co.

271 Flexible Hose, Bellows — Sixteen-pp Catalog 156 describes applications and use of flexible metal hose and bellows. Engineering specifications and sizes, pressure ratings, materials and fitting attachments are included. Detailed drawings and pictures facilitate specification of individual applications. Charts of the various metal-formed bellows and hose are provided. Flexonics Corp.

INSTRUMENTS, CONTROLS

272 Meters and Controls — Over 100 measuring, transmitting, receiving, recording and indicating instruments and control components, including those introduced within the last year, are described in the 8-pp 1957 edition of company's Bulletin G15-1. Applications, ranges, and detailed literature references are given for each product. Bailey Meter Co.

273 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes refer-

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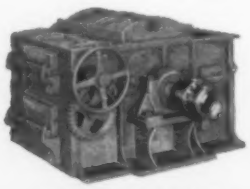

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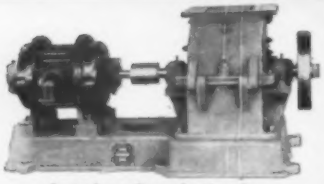

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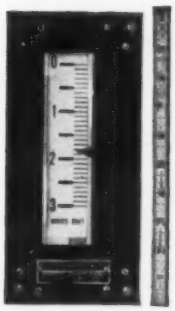

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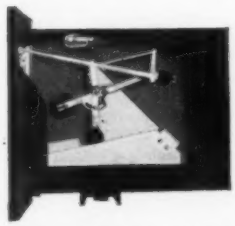

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ences to detailed literature on each type of equipment. Republic Flow Meters Co.

274 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, and explains operation. The Reliance Gauge Column Co.

275 Guide to Gages — Catalog 300-B, 112 pp, features Ashcroft Duragauges, Maxisafe, pneumatic receiver, recording, quality, drawn casem chemical and special application gages. Also presented are gage testers, pneumatic transmitters, gages for nuclear energy. Engineering data and charts are provided. Instruments shown cover dial sizes from 2 through 24 in., pressures from 30 in. vacuum or a few ounces up to 100,000 psi. Manning, Maxwell & Moore, Inc.

276 For Feedwater Analysis — Bulletin 148BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

277 Steam Calorimeter — This bulletin discusses an improved U-path calorimeter combining a throttling, separating and re-evaporating calorimeter in a single chamber. Explains construction and operation of unit. Ellison Draft Gage Co., Inc.

278 Pressure Regulators — Form 1011, on flow regulators, provides selection data with photos on three principal types of main valves and pilots. Also illustrated by line drawings are three suggested applications of regulators. A steam capacity table for the selection of main valve size is also shown. Spence Engineering Co., Inc.

279 Tube Expansion Control — Bulletin 64 describes a tube expansion control which automatically controls expansion by accurate measurement of torque. Advantages are detailed and specification data furnished. Airetool Mfg. Co.

280 Cooling Controls — Bulletin 710B describes company's self-powered cooling controls for compressors, stills, solvent coolers, degreasers, oil coolers, small engines, condensers, others. Includes hook-up sketches. Sarco Co., Inc.

OTHER EQUIPMENT

281 Product Guide — Manufacturing facilities for company's line of steam turbines, turbine generators, ship propulsion units, feed pumps, centrifugal compressors, blowers, centrifugal pumps, reduction gear, and other products are described in this profusely illustrated 50-pp catalog. Photos show manufacturing procedure. De Laval Steam Turbine Co.

283 Sheet and Plate Fabrication — Illustrated in 40-pp Bulletin F-3 are products of this manufacturer, and equipment used to produce special sheet steel and alloy parts. Shows control panels, switch gear housings, cubicles and other electrical enclosures, boiler air ducts, smoke breechings, tanks. The Kirk & Blum Mfg. Co.

284 Centrifugal Dust Collector — Twelve-pp Bulletin 100 introduces the Cyclo-trell multiple tube dust collector which operates on centrifugal collection principles and incorporates new features to boost collection efficiency and gas handling capacity. An illustrated explanation of operation and construction of this collector is accompanied by collection efficiency and capacity nomographs. Tables give design data for six sizes, from three to 20 tubes. Research-Cottrell, Inc.

285 Electric Heating Units — Catalog 50, 50 pp, contains complete engineering data on electrical heating units and equipment, including strip elements, finstrip elements, tabular elements, cartridge elements, ring elements, immersion heaters, circulation heaters, radiant heaters, forced air duct heaters, unit heaters, hot plates and others. Includes photos, dimensional drawings, prices, standard rating tables, and specifications. Edwin L. Wiegand Co.

286 Ejector Data — This 12-pp bulletin presents company's steam jet air ejectors designed for efficient, low cost air removal from condensers. Illustrates basic ejector assembly, and discusses principle of operation. Single- and multi-stage units are shown. Also described are steam jets for special services and air ejector accessories. Engineering, data pertinent to ejector application in power plants, process plants and evaporators included. Condenser Service and Engineering Co., Inc.

287 Engineering For Atomic Power — How $400 million in coin silver weighing 14,000 tons were borrowed from the U. S. Treasurer for use as electrical conductors, at the atomic energy plant in Oak Ridge, during the war when copper was scarce, is told in this 36-pp illustrated booklet. Describes the firm's role in the development of atomic energy and outlines its

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activities in peacetime applications. Stone & Webster Engineering Corp.

288 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

291 Equipment For Process Industries — Eight-pp Bulletin G-3 describes company's line of equipment for the process industries, including a conveying system for bulk materials, the Airveyor — a pneumatic conveying system, — the Airslide for transporting fine, dry materials without use of moving parts, as well as compressors and pumps, coolers and preheaters. Photos, cutaway drawings, and performance details are included. Fuller Co.

292 Low-Pressure Heating Plant — Guide specifications for typical low-pressure commercial heating plants are presented in this 53-pp publication. Scope of guide specifications and basis of recommendations are detailed, and an index to specifications is given. Tabulated data are included along with drawings of typical boiler room, over fire air system, and electric boiler controls & stacks. Bituminous Coal Institute.

293 Products and Services — Bulletin SSP-901, 24 pp, describes products and services of this company and its various divisions. Among products described are ring balance instruments, components for control systems, electronic devices, force measuring devices, water and steam treatment and testing equipment, chemical feeding equipment, chemical products for boiler water and steam conditioning, reagents, and a variety of products for water-conditioning, food processing, paper processing, metal cleaning, others. Hagan Chemicals & Controls, Inc.

294 Brine-Making Manual — Details on modern brine-making methods and equipment are presented in 12-pp Manual 135. Three types of brine-makers are described, as well as a wet salt storage system, and cutaway views and diagrams are included. Morton Salt Co.

295 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

296 Turbine Speed Control — Thirty-pp wire-bound Bulletin H-21 is titled "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

297 Power Plant Equipment — Bulletin 1022-B, 12 pp, describes various types of power plant equipment, including combustion control, boiler feed water control, pressure reducing, desuperheating and soot blowing. Photos and drawings illustrating equipment are included. Copes-Vulcan Div., Blaw-Knox Co.

298 Insulated Stack — This illustrated folder on company's pre-cast insulated stack contains complete product information, including advantages and description, specifications, suggested installation methods. Van-Packer Corp.

299 Metal Laminates — Types of metal laminates, metals which can be laminated, and use in heat exchangers, electronics and other applications are detailed in this illustrated 8-pp bulletin. Advantages and properties are described, and size data given. Bridgeport Brass Co.

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Troubles at the Ice Plant . . .
and how they were solved

By C. T. BAKER

LEAK DEVELOPED in the evaporator coils of a 30-ton ice-making tank. The tank contained a total of 360 300-lb cans. The leak developed during the night but was not discovered until the following morning. By that time the brine solution was badly contaminated with ammonia.

While the leak was being repaired, a sample of the brine was sent to a firm of chemists in a near-by city for analysis and for recommendations as to the amount of muriatic acid that would be required to neutralize the brine.

Chemists advised as to the net amount of brine in the tank after allowances had been made for the displacement of the cans, the coils and headers.

After receiving the report of the chemists, the manager secured a carboy of muriatic acid and instructed the ice puller to remove one of the cans and dump the contents into the brine. This he did, under supervision of the manager. The net result of this action was to produce a high of concentration of acid in the brine, which later resulted in the loss of the galvanizing on the exterior surfaces of the cans, which greatly reduced their life expectancy. Before the close of the summer, several cans leaked so badly that they had to be replaced.

Had the acid been introduced at either of the two brine propellers in small quantities it would have been thoroughly mixed with the brine and prevented the high concentration of acid in certain areas of the tank.

Adding acid to brine to reduce alkalinity should not be a "shock" treatment but a gradual one where small quantities are added and the brine tested with litmus paper or other appropriate tests to determine the pH of the brine. Tests should be made at the same time to determine the degree of acidity or alkalinity.

In many situations it is far better to dump the brine, wash out the tank and make new brine. The plan followed in the case described above proved most costly.

Case of the Damaged New Cans

New ice-freezing tank was installed to replace an old one that had become obsolete, in addition to being in bad physical condition. Furnished with the new tank was a complete set of 300-lb capacity ice cans.

Calcium chloride brine was used. Since there was need to get the tank into service in a hurry, the solid calcium was broken into small lumps and dissolved in a large mixing box that rested on the tank framework. The tank had been filled to a little under the half-way mark with fresh water which was circulated over the broken calcium by two circulating pumps.

By the time the work was finished, the temperature of the brine was about 98 F.

In the haste to get into production, all cans were filled and placed in the tank of hot brine. The compressor was then started and continued to operate until all cans were frozen and ready for harvesting. With the beginning of ice-pulling operations, the compressor was placed in service and operated through the summer, holding the brine temperature at from 14 to 15 F.

Soon after the plant was placed in regular operation, it was noticed that the galvanizing on the cans was being destroyed. This was evidenced by the appearance of rust on the cans. The plant owners at first contended that the galvanizing was defective. This claim, however, was not supported by the facts, as developed by an impartial investigation, which absolved the manufacturer.

To prevent trouble from hot or warm brine, it is recommended that the brine be cooled to at least 40 F before placing the cans in the tank; also, when mixing brine, sodium dichromate should be added to the calcium or to the salt, as the case may be. Amount of corrosion inhibitor added to the mix should be as recommended by the American Society of Refrigeration Engineers.

"Joe, you wouldn't buy the engine of your car from one manufacturer, the wheels from another and the body from still another, would you? Neither would I. And when I design for induced draft, I specify a P-D Stack because the I.D. Fan, though it is important, isn't the whole story. The combined breeching, stack and fan, built as ONE apparatus, gives me unit responsibility, compact design, simplified engineering, and positive performance, with a lot less purchasing details.

"Another thing, I'd rather buy my Dust Collector from the same manufacturer that made my Stack and Fan. For this is all part of the same system for handling the gas after it leaves my boiler unit.

"There's nothing like putting all the responsibility on ONE manufacturer's shoulders if you can, for then you'll come out on the long end nine times out of ten. Buying such equipment piece-meal is antiquated and costly."

You can save a lot of time, trouble and money by purchasing your Stack and Dust Collector from Prat-Daniel.

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Agency—G. M. Basford Company
AEROTEC CORP. ..... *
Agency—Babcock, Romer, Carberry & Murray, Inc.
AIRETOOL MFG. CO., THE 122
Agency—Harry M. Miller, Inc.
ALLIS-CHALMERS MFG. CO. 17
Agency—Compton Advertising Inc.
AMERICAN BLOWER CORP. ..... *
Agency—Brooke, Smith, French & Dorrance, Inc.
AMERICAN BRASS CO. 137
Agency—Kenyon & Eckhardt, Inc.
AMERICAN CHAIN & CABLE CO. 64
AUTOMOTIVE & AIRCRAFT DIV.
Agency—Reincke, Meyer & Finn Inc.
AMERICAN CHIMNEY CORP. 154
AMERICAN ENGINEERING CO. ..... *
Agency—Hazard Advertising Co.
AMERICAN GILSONITE CO. ..... *
Agency—Fred Wittner Advertising
AMERICAN PULVERIZER CO. 150
Agency—Batz-Hodgson-Neuwoehner
ANDERSON CO., V. D. ..... *
Agency—Will Inc.
ARMSTRONG MACHINE WORKS 7, 153
Agency—Russell T. Gray, Inc.
ATOMICS INTERNATIONAL 51
Agency—Batten, Barton, Durstine & Osborn, Inc.
AURORA PUMP DIVISION, THE NEW YORK AIR BRAKE CO. 151
Agency—Fred A. Hinrichsen Advertising Agency
AUTOMOTIVE & AIRCRAFT DIV. 64
AMERICAN CHAIN & CABLE CO.
Agency—Reincke, Meyer & Finn Inc.

BABBITT STEAM SPECIALTY CO. ..... *
Agency—George T. Metcalf Co.
BABCOCK & WILCOX CO., THE (BOILER DIV.) 10–11
Agency—O. S. Tyson and Co., Inc.
BABCOCK & WILCOX CO. (REFRACTORIES DIV.) 71
Agency—Michel-Cather, Inc.
BAILEY METER COMPANY 115
Agency—Fuller & Smith & Ross, Inc.
BALDWIN-HILL CO. 111
Agency—Eldridge, Inc.
BALTIMORE & OHIO RR. ..... *
Agency—Richard A. Foley, Inc.
BARCO MANUFACTURING CO. ..... *
Agency—Armstrong Advertising Agency
BELMONT PACKING & RUBBER CO., THE 134
Agency—The Michener Co.
BETZ LABORATORIES, INC. 107
Agency—The Michener Co.
BIDDLE CO., JAMES G. ..... *
Agency—The Roland G. E. Ullman Org.
BIRD-ARCHER CO., THE ..... *
Agency—The Roland G. E. Ullman Org.
BITUMINOUS COAL INSTITUTE 20–21
Agency—VanSant Dugdale & Co., Inc.
BOILER ENGINEERING & SUPPLY CO. ..... *
Agency—William Jenkins Advertising
BOWSER, INC. ..... *
Agency—Willis S. Martin Co.
BRIDGEPORT BRASS CO. 72
Agency—Hazard Advertising Co., Inc.
BUFFALO FORGE COMPANY ..... *
Agency—Melvin F. Hall
BUSSMANN MFG. CO. 12–13

C & D BATTERIES ..... *
Agency—John T. Hall & Co.
CAMBRIDGE INSTRUMENT CO., INC. 151
Agency—E. M. Freystadt Associates, Inc.
CHAPMAN VALVE MFG. CO., THE ..... *
Agency—Sutherland-Abbott
CHESAPEAKE & OHIO RAILROAD ..... *
Agency—Robert Conahay, Inc.
CHILDERS MFG. CO. ..... *
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Agency—Graves & Associates, Inc.
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Agency—Babcock, Romer, Carberry & Murray, Inc.
COMBUSTION ENGINEERING, INC. 18–19
Agency—G. M. Basford Company
COPES-VULCAN DIV., BLAW-KNOX CO. 135
Agency—Ketchum MacLeod & Grove Inc.
CRANE CO. 117
Agency—The Buchen Company
CRANE PACKING CO. ..... *
Agency—Symonds, MacKenzie & Co., Inc.

DEARBORN CHEMICAL CO. 133
Agency—The Buchen Co.
DE LAVAL STEAM TURBINE CO. 8
Agency—Michel-Cather, Inc.
DETROIT STOKER COMPANY ..... *
Agency—Witte & Burden
DIAMOND POWER SPECIALTY CORP. 119
Agency—Witte & Burden
DODGE MANUFACTURING CO. 137
Agency—Lamport, Fox, Prell & Dolk, Inc.

EDWARD VALVES, INC. 40–41
Agency—Marsteller, Rickard, Gebhardt & Reed Inc.
ELLIOTT CO. 59, 144
Agency—Downing Industrial Advertising, Inc.
ELLISON DRAFT GAGE CO. 152
Agency—Tri State Advertising Co., Inc.
ENGINEER CO., THE ..... *
Agency—Michel-Cather, Inc.
ERIE CITY IRON WORKS 24–25
Agency—Davies and McKinney
EVERLASTING VALVE CO. 126
Agency—Michel-Cather, Inc.

FAIRMOUNT CHEMICAL CO., INC. 154
FELT PRODUCTS MFG. CO. ..... *
Agency—Hanson & Stevens, Inc.
FLEXONICS CORP. 147
Agency—O'Grady-Andersen-Gray, Inc.
FOSTER WHEELER CORP. 14–13, 73
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
FULLER CO. 132
Agency—O. S. Tyson & Co., Inc.

GENERAL COAL CO. 158
Agency—The Aitkin-Kynett Co.
GENERAL ELECTRIC CO. 28–29
Agency—G. M. Basford Co.
GLOBE CO., PRODUCTS DIV. 124
Agency—Ross Llewellyn, Inc.
GOODALL RUBBER CO. ..... *
Agency—George C. Taylor Advertising
GRAVER WATER CONDITIONING 2
Agency—Trade Method Advertising

HAGAN CHEMICALS & CONTROL, INC. 127
Agency—Ketchum, MacLeod & Grove, Inc.
HALLIARD CORPORATION, THE ..... *
Agency—Mellor Advertising Agency, Inc.
HILLS McCANNA CO. 139
Agency—Waldie & Briggs, Inc.
HUYETTE CO., INC., THE PAUL B. ..... *

ILLINOIS WATER TREATMENT CO. 146
Agency—Cummings, Brand & McPherson
INFILCO INC. ..... *
Agency—Willard C. Gregory & Co.
INTERNATIONAL NICKEL COMPANY, INC., THE 129
Agency—Marschalk & Pratt Co. Division of McCann-Erickson, Inc.

JERGUSON GAGE & VALVE ..... *
Agency—Ray Elliott Co.
JOHNSON-MARCH CORP. ..... *
Agency—Beaumont, Heller & Sperling, Inc.
JORDON CORP. ..... *
Agency—Haehnle Corp.

KAISER ENGINEERS 42
E. KEELER CO. ..... *
Agency—Charles E. Williams Advertising
KEWANEE BOILER DIVISION 113
Agency—Arbingast, Becht & Associates, Inc.
KIRK & BLUM MFG. CO. 128
Agency—Baer, Kemble & Spicer
KOPPERS CO., INC. 16
Agency—VanSant Dugdale & Co., Inc.
KOR CORPORATION 151
Agency—Kreicker & Meloan, Inc.
KRETCHMER, F. P. ..... *

LADISH CO. 53–58
Agency—The Cramer-Krasselt Co.
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Agency—Reid, Decker & Stocki, Inc.
LUKENS STEEL COMPANY 109
Agency—J. M. Mathes, Inc.

MADDEN CORP. ..... *
MANNING, MAXWELL & MOORE, INC. 33
Agency—Fuller & Smith & Ross, Inc.
MARLEY CO., THE 123
Agency—Valentine-Radford Advertising
MARYLAND SHIPBUILDING & DRYDOCK CO. 145
Agency—Speed & Company, Inc.
MEAD-MORRISON DIVISION, McKIERNAN-TERRY CORP. 39
Agency—Kriegp Associates
MILTON ROY CO. 67
Agency—The Aitkin-Kynett Co.
MOORE & CO., SAMUEL ..... *
Agency—Palm & Patterson
MORTON SALT CO. 37
Agency—Needham, Louis & Brorby, Inc.

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Agency—Tri State Advertising Co., Inc.
NATIONAL AIROIL BURNER COMPANY, INC. 148
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NATIONAL ALUMINATE CORPORATION ..... *
Agency—Armstrong Advertising Agency
NEW ENGLAND CARBIDE TOOL CO. ..... *
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Agency—The Ralph H. Jones Co.
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Agency—Pearsall & Schael
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Agency—Hollander & Weghorn
PREFERRED UTILITIES MFG. CORP. ..... *
Agency—Spooner & Kriegel
PROPORTIONEERS INC. ..... *
Agency—Horton, Church & Goff, Inc.

RAYBESTOS-MANHATTAN, INC. 68
Agency—Gray & Rogers
REFRACTORY & INSULATION CORP. ..... *
Agency—Spooner & Kriegel
RELIANCE GAUGE COLUMN COMPANY 138
Agency—Carr Liggett Advertising Inc.
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Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
RESEARCH-COTTRELL ..... *
Agency—Michel Cather, Inc.
RIC-WIL, INC. ..... *
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RILEY STOKER CORPORATION 30–31
Agency—Seth R. Martin
ROCKWELL CO., W. S. 146
Agency—Spooner & Kriegel
ROTO DIV. OF ELLIOTT CO. 66
Agency—Jos. Vogel & Co.

SARCO COMPANY, INC. 143
Agency—G. M. Basford & Co.
SINCLAIR REFINING CO. ..... *
Agency—Morey, Humm & Warwick, Inc.
SOCONY MOBIL OIL CO., INC. 34–35
Agency—Compton Advertising, Inc.
SPENCE ENGINEERING CO. 38
Agency—Michel-Cather, Inc.
STANDARD OIL CO. (INDIANA) 69
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Agency—Connor Associates, Inc.
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Agency—Charles M. Davis

TAYLOR & CO., W. A. ..... *
Agency—Emery Advertising Corporation
THE TERRY STEAM TURBINE CO. 70
Agency—Gassaway Advertising Agency
TEXAS CO., THE ..... Back Cover
Agency—G. M. Basford Co.
TROY ENGINE & MACHINE CO. ..... *
Agency—Laux Advertising, Inc.

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Agency—William Hart Adler, Inc.
UNION IRON WORKS ..... *
Agency—Harold Warner Co.
U. S. ELECTRICAL MOTORS 121
Agency—The McCarty Co.
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Agency—Batten, Barton, Durstine & Osborn, Inc.

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Agency—Farson, Huff & Northlich

WEBSTER MFG. CO. ..... *
Agency—The Morgan Advertising Co.
WESTERN CHEMICAL COMPANY 149
Agency—Rogers & Smith Advertising Agency
WESTERN PRECIPITATION CORP. ..... Inside Back Cover
Agency—Dozier Eastman & Co.
WICKES BOILER CO. ..... *
Agency—Price, Tanner & Willox, Inc.
WIEDEKE CO., THE GUSTAV ..... *
Agency—Hutzler & Associates, Inc.
WIEGAND CO., EDWIN L. ..... *
Agency—Ketchum, MacLeod & Grove, Inc.
WILLIAMS GAUGE CO. 148
Agency—Downing Industrial Advertising, Inc.
WILSON, INC., THOMAS C. 158
Agency—Michel-Cather, Inc.
L. J. WING MFG. CO. 26–27
Agency—Michel-Cather, Inc.
WORTHINGTON CORPORATION ..... *
Agency—Needham, Louis & Brorby, Inc.

YARNALL-WARING COMPANY 8–9, 74
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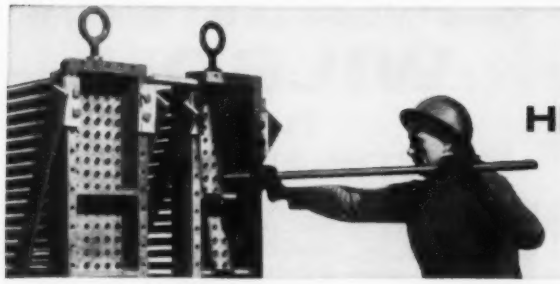
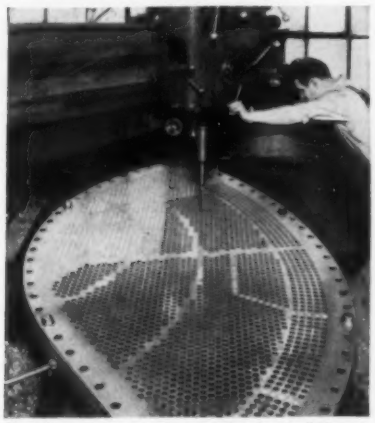


CONDENSER AND HEAT EXCHANGER CLINIC

Edited by Arthur W. Tracy, Metallurgical Engineer
The American Brass Company, Waterbury, Conn.

Selecting alloys for rolled tube sheets and baffles

Tube sheets and baffles are available from The American Brass Company in a wide variety of shapes, sizes and alloys to meet the problems of corrosion, pressure, and temperature encountered in condensers and heat exchangers.



Reaming a large condenser tube sheet of Naval Brass-450.

The following Anaconda alloys are those most widely used for tube sheets and baffle plates.

Leaded Muntz Metal-274 has good strength, stiffness and elasticity. It machines well and is the most commonly used tube-sheet metal. Leaded Muntz Metal hot rolls easily and can be manufactured in very large sizes. Many of the other tube-sheet alloys are superior to Leaded Muntz Metal in corrosion resistance and are used in preference to it for that reason. However, tube sheets are necessarily so thick that a long time elapses before they are affected by corrosion to the extent that their strength or usefulness is impaired.

Naval Brass-450 is an alloy of the same general type as Leaded Muntz Metal but includes approximately 0.75% tin in its composition. The tin content increases the alloy's resistance to corrosion, and makes it preferable to Leaded Muntz Metal, especially at higher-than-normal working temperatures. Hot-working properties of Naval Brass are similar to those of Leaded Muntz Metal.

Arsenical Admiralty-439 is resistant to dezincification corrosion and can be used where its higher resistance to corrosion is required, especially in process equipment.

Ambraloy-917 is available for use where strength and corrosion resistance superior to Naval Brass and Admiralty Metal are desired, as in oil-cooler tube sheets.

Cupro Nickel, 10%-755 and Cupro Nickel, 30%-702 are used extensively with tubes of similar composition in marine condensers and process heat exchangers.

Baffle and Support Plates for use in oil-refinery equipment are most often of Leaded Muntz Metal and Yellow Brass. For more severe applications, Admiralty, Naval Brass, Cupro Nickel, Copper and Everdur® are often employed.

Rolled Plates Superior. Anaconda sheets, plates, and circles are produced by the rolling process. They are commercially flat, accurate in dimensions, and free from the surface imperfections and porosity often prevalent in cast plates.

Standard Sizes. The American Brass Company makes plates for condenser tube sheets of copper and a number of copper alloys in rectangular sizes up to 156 inches in width and weights up to 15,000 pounds for any shape that can be cut from such sheet. The maximum standard limits for circles are 160 inches in diameter and 11,000 pounds in weight. Half circles can be produced up to 13,000 pounds in weight.

Rolled circles of Ambraloy-917, 2" thick, for water-to-water heat exchanger tube sheets requiring superior strength and corrosion resistance. Such circles can be furnished up to 5" thick, offer savings in material cost over comparable circles produced by the forging process.

Special jobs. When specifications call for extremely large plates or special alloys for special applications, The American Brass Company will gladly cooperate in the solution of such problems. For further information on Anaconda Condenser Tubes or Tube Sheets write: The American Brass Company, Waterbury 20, Conn. 6675

Nominal compositions of Anaconda condenser tube sheet and plate stock

Alloy	Copper %	Zinc %	Tin %	Nickel %	Aluminum %	Lead %	Manganese %	Phosphorus %	Silicon %	Iron %	Arsenic %
Leaded Muntz Metal-274	60.0	39.40	—	—	—	0.60	—	—	—	—	—
Naval Brass-450	60.0	39.25	0.75	—	—	—	—	—	—	—	—
Arsenical Admiralty-439	71.0	27.96	1.0	—	—	—	—	—	—	—	0.04
Ambraloy-917 (Aluminum Bronze)	82.0	—	—	5.0	9.50	—	1.0	—	—	2.50	—
Cupro Nickel, 30%-702	68.9	—	—	30.0	—	—	0.60	—	—	0.50	—
Cupro Nickel, 10%-755	88.35	—	—	10.0	—	—	0.40	—	—	1.25	—
Phosphorized Copper-103	99.90+	—	—	—	—	—	—	0.02	—	—	—
Everdur®-1010	95.80	—	—	—	—	—	1.10	—	3.10	—	—

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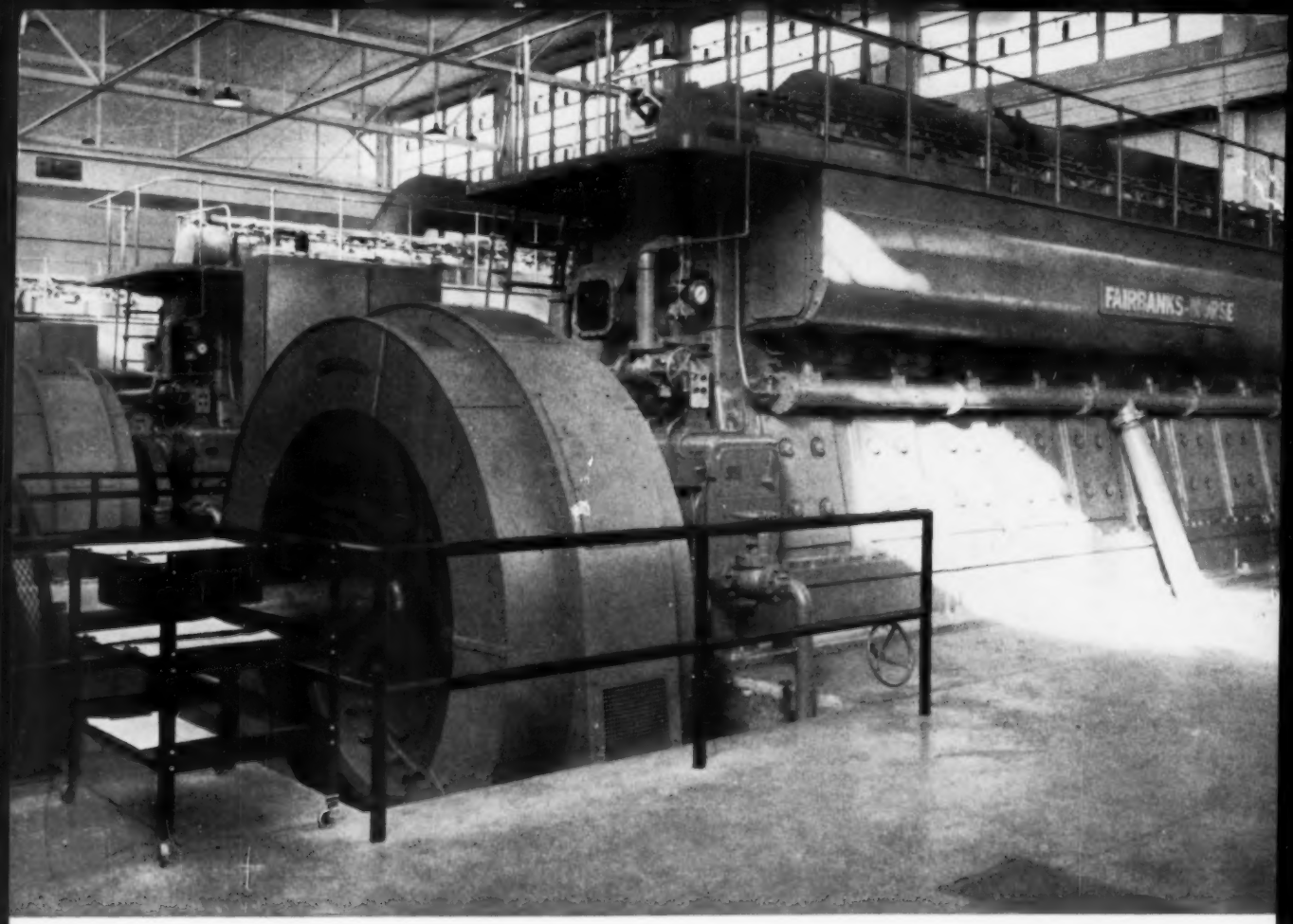

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